Integrated Energy Resources

DELAWARE ECONOMIC ENERGY EFFICIENCY POTENTIAL

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Prepared for:

Delaware Department of Natural Resources and Environmental Control

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EXECUTIVE SUMMARY

BACKGROUND AND PURPOSE OF STUDY

The Delaware Department of Natural Resources and Environmental Control (DNREC) commissioned this study to estimate the economic energy efficiency potential in Delaware for electricity, natural gas and unregulated fossil fuel usage (petroleum fuels) in the buildings sector.[1] Optimal Energy, Inc. led the study, with assistance from Shelter Analytics and Energy Futures Group. This report covers Phase I of the project focusing on the economic potential, which reflects an upper bound of the amount of efficiency that could be pursued. It is intended to frame the magnitude of the efficiency opportunity in Delaware to support consideration of policy alternatives, and to be a stepping stone for a second phase. Phase II is planned to assess the economically *achievable* potential to better inform future Delaware efficiency program goals and planning.

Economic efficiency potential is defined as the total opportunity for efficiency improvement that passes a cost-effectiveness test, assuming all energy efficiency opportunities that pass that test are adopted without regard to any market barriers or assumptions about how many people would actually choose to adopt them. For this study, cost-effectiveness is defined by the Participant Cost Test, which considers measures as cost-effective so long as the total lifetime cost savings to the energy consumer (based on retail energy costs) exceed the up-front initial efficiency measure investment. Measures are considered to pass the test when their benefits exceed or equal their cost, thus when the benefit-cost ratio is greater than or equal to 1.0.

Economic potential was estimated for a 12-year period, from 2014 to 2025. Due to schedule and budget constraints, this study relies solely on existing available data, and did not include any new primary data collection. Whenever possible existing data from Delaware or the Mid-Atlantic region was relied on.

SUMMARY RESULTS

Key findings include:

- Total electric economic potential is 4,091 GWh, representing 26.3% of the 2025 base case forecasted load.[2] If captured, this would result an average annual load *decrease* of 1.6% per year.

[1] Petroleum fuels included oil #2, #4 and #6, propane and kerosene. All petroleum fuel potential was estimated in aggregate and is not provided for each individual fuel.

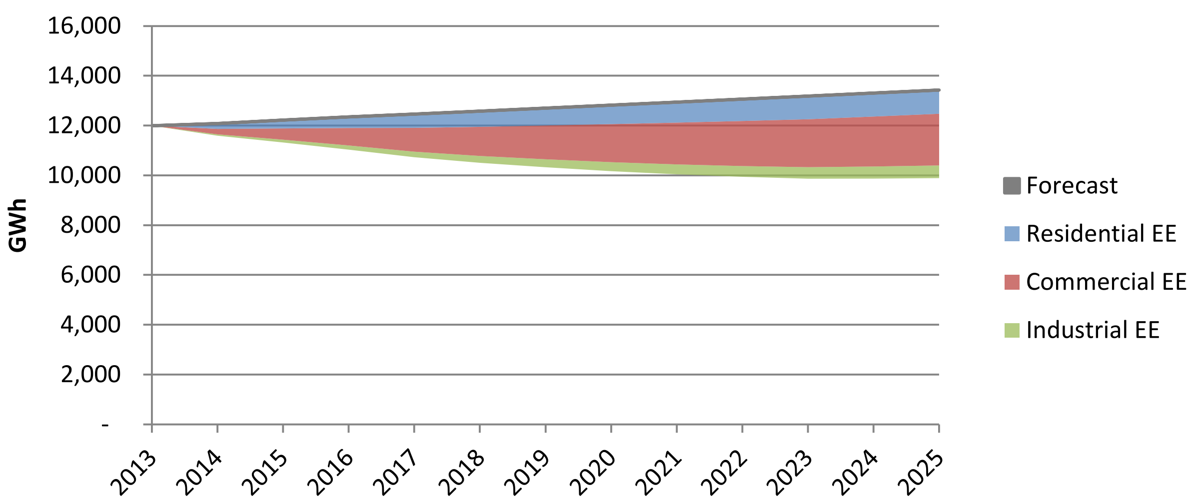
[2] All electric energy (kWh) values sited in this report are at generation or point-of-purchase, and do not include line losses. See Appendix F (page 91) for the line loss factor used to convert from savings at the customer meter.

- Total natural gas economic potential is 8,234 billion Btu (BBtu), representing 19.6% of the 2025 base case forecasted load. If captured, this would result an average annual load *decrease* of 1.4% per year.
- Total petroleum fuels economic potential is 1,319 BBtu, representing 12.6% of the 2025 base case forecasted load. If captured, this would result an average annual load *decrease* of 0.9% per year.

Total cumulative economic potential by fuel is shown below in Figures 1 to 3, as well as Table 1.[3] As can be seen in Figures 1 to 3, adopting all cost-effective measures in all Delaware buildings and factories would more than offset expected load growth through 2025, resulting in a downward trend in energy usage in the buildings sector in Delaware. How much of that can actually be captured cost-effectively with efficiency programs, and the costs of capturing it, have not been evaluated in this phase of the project.

The analysis considers efficiency potential by sector, or customer class: residential, commercial (including institutional and government), and industrial. We find the potential greatest in the commercial sector, with 39.2%, 33.3% and 34.1% reductions in usage by 2025 for electricity, gas and petroleum fuels respectively. The residential sector is the next highest at respective reductions of 18.0% (electric), 17.4% (gas) and 6.0% (petroleum). Finally, the industrial sector potential is estimated at 17.9% (electric), 13.4% (gas) and 8.6% (petroleum).

Figure 1. Electric Total Forecast and Economic Efficiency Potential by Sector



[3] The 2025 "cumulative" potential means the total potential efficiency savings due to all efficiency measures installed or adopted during the 12-year study period, but not including the savings of measures that reached the end of their effective useful life prior to 2025.

Figure 2. Natural Gas Forecast and Economic Efficiency Potential by Sector

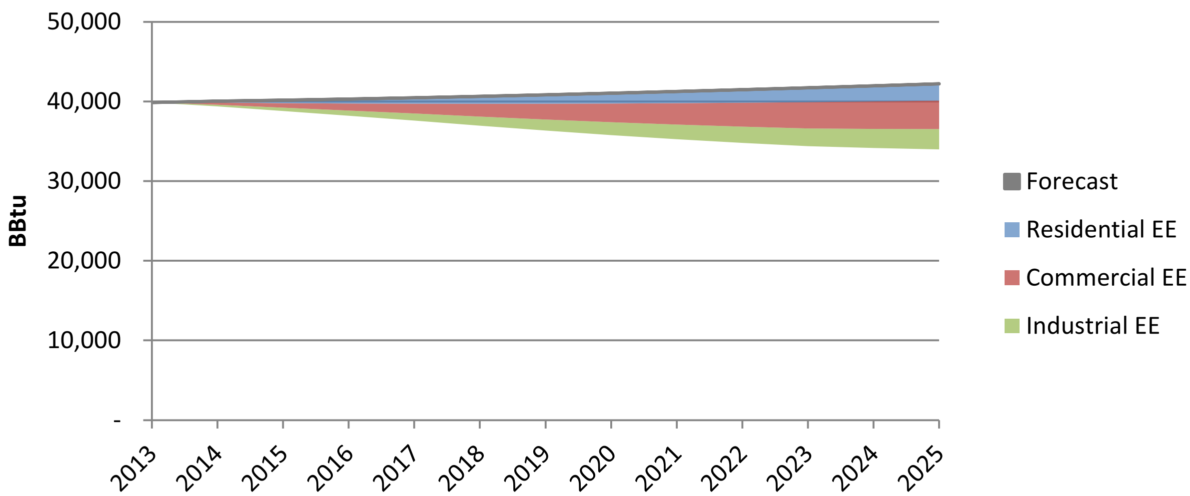


Figure 3. Petroleum Fuels Forecast and Economic Efficiency Potential by Sector

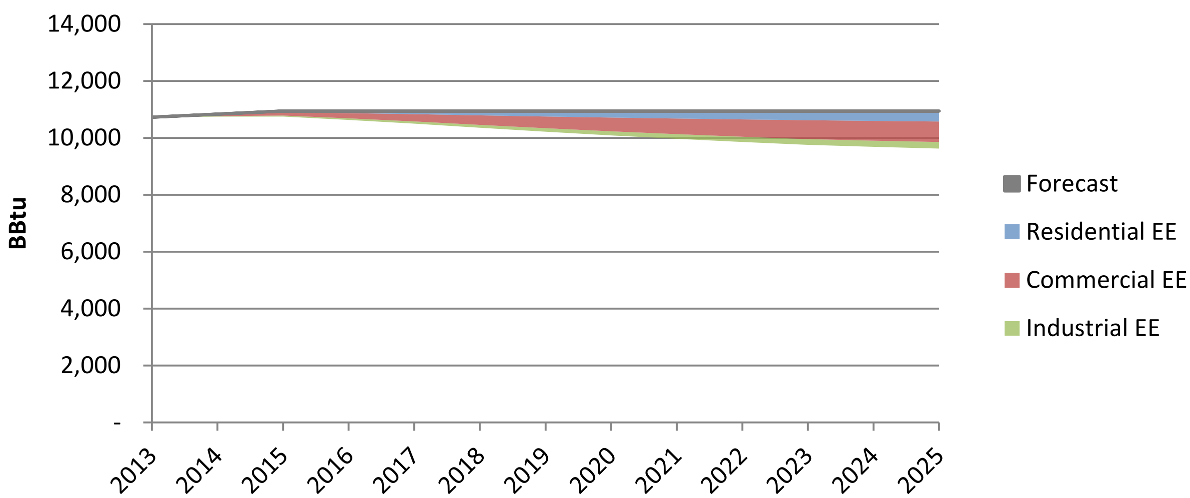


Table 1. Summary of Cumulative Efficiency Potential Relative to Forecast (2025)

	Forecast	Cumulative Savings	% of Forecast
Electric (GWh)			
Residential	5,284	952	18%
Commercial	5,292	2,076	39%
Industrial	2,848	509	18%
Total	13,424	3,537	26%
Natural Gas (BBtu)			
Residential	12,266	2,109	17%
Commercial	10,873	3,572	33%
Industrial	19,071	2,553	13%
Total	42,210	8,234	20%
Petroleum Fuels (BBtu)			
Residential	6,136	368	6%
Commercial	2,103	720	34%
Industrial	2,699	231	9%
Total	10,938	1,319	12%

If the total economic potential were hypothetically captured, it would produce $438 million in net benefits (in real 2013 $) to the Delaware economy, at a benefit-cost ratio of 4.01. Total investment would be $146 million, with benefits to consumers (mostly energy bill savings) of $584 million. Table 2 shows the cumulative economic impacts through 2025, broken out by sector.

Table 2. Summary of Cumulative Participant Costs and Benefits by Sector (2025)

Sector	Benefits (Million $)	Costs (Million $)	Net Benefits (Million $)	BCR
Residential	$194	$57	$137	3.39
Commercial	$322	$75	$247	4.30
Industrial	$68	$14	$54	4.95
Total	$584	$146	$438	4.01

Figures 4 to 6 show efficiency supply curves by fuel. These graphically provide a sense of where the savings come from and how much potential is available from what sectors and end uses at different levels of cost-effectiveness. The Y-axis is the participant benefit-cost ratio, with the X-axis representing the total cumulative potential savings in 2025. All of the efficiency shown on the supply curves is cost-effective, with a benefit-cost ratio of at least 1.0. As can be seen, the efficiency opportunities are widely intermixed across sectors and by BCR. For electric efficiency, the commercial opportunities generally provide larger savings opportunities with higher BCRs than residential, while the industrial potential is largely concentrated in the process end use. For natural gas and petroleum fuels the potential is distributed mainly across space heating, water heating, and industrial process, with varying cost-effectiveness.

Figure 4. Economic Electric Energy Efficiency Supply Curve by Sector and End Use

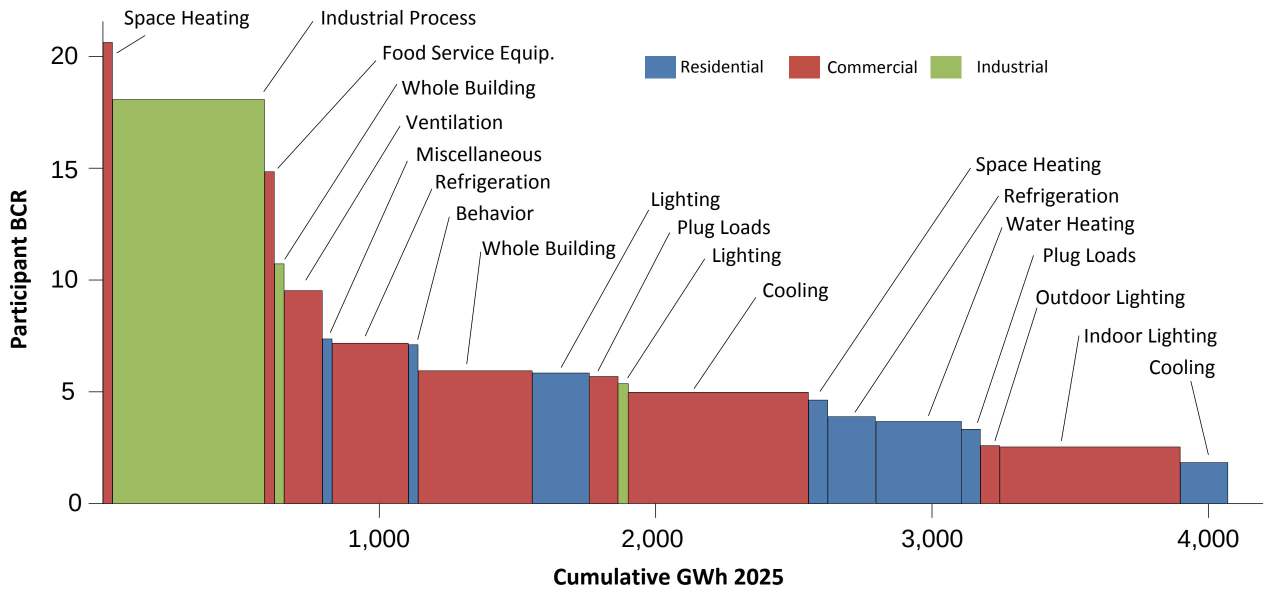


Figure 5. Economic Natural Gas Energy Efficiency Supply Curve by Sector and End Use

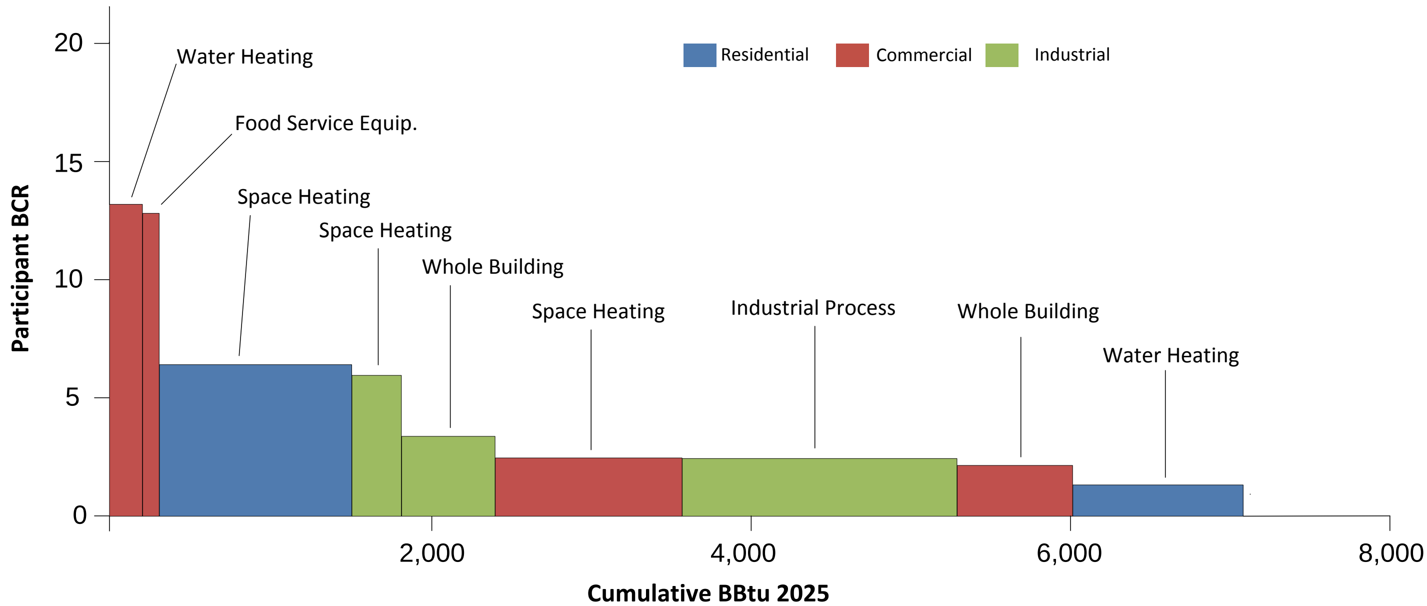
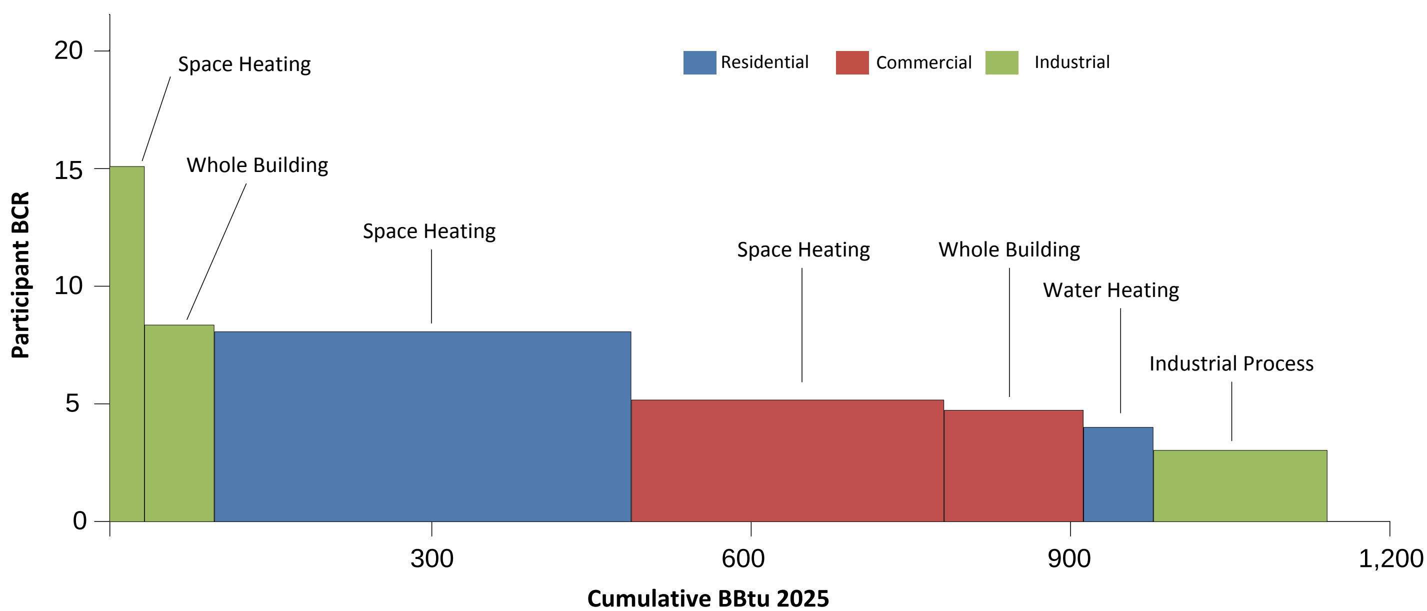


Figure 6. Economic Petroleum Fuel Energy Efficiency Supply Curve by Sector and End Use



METHODOLOGY

The Methodology section of the main report provides a more detailed discussion of the methods and assumptions used in the analysis. The steps below summarize the methodological approach for this project.

- Assess and adjust the energy forecasts for each fuel type for any known codes and standards, and estimate naturally occurring efficiency adoption to ensure it properly reflects consistent base case assumptions about customers and end uses.
- Disaggregate adjusted energy forecasts by sector (residential, commercial, industrial), by market segment (e.g., building types), and end uses (e.g., lighting, cooling, etc.).
- Characterize efficiency measures, including estimating costs, savings, lifetimes, and share of end use level forecasted usage for each market segment.
- Build up savings by measure/segment based on measure characterizations calibrated to total energy usage.
- Account for interactions between measures, including savings adjustments based on other measures as well as ranking and allocating measures when more than one measure can apply to a particular situation.
- Run the stock adjustment model to track existing stock and new equipment purchases to capture the eligible market for each measure in each year.
- Run the efficiency potential model to estimate total potential for each measure/segment/market combination to produce potential results.
- Screen each measure/segment/market combination for cost-effectiveness, for each install year of the 12-year study period. Remove failing measures from the analysis and rerun the model to re-adjust for measure interactions.

INTRODUCTION

BACKGROUND AND PURPOSE OF STUDY

The Delaware Department of Natural Resources and Environmental Control (DNREC) commissioned this study to estimate the economic efficiency potential in Delaware for electricity, natural gas and unregulated fossil fuel usage (petroleum) in the buildings sector.[4] Optimal Energy, Inc. led the study, with assistance from Shelter Analytics and Energy Futures Group. This report covers Phase I of the project focusing on the economic potential, which reflects an upper bound of the amount of efficiency that could be pursued. It is intended to frame the magnitude of the efficiency opportunity in Delaware to support consideration of policy alternatives, and to be a stepping stone for a second phase. Phase II is planned to assess the economically *achievable* potential to better inform future Delaware efficiency program goals and planning.

Economic potential is defined as the total opportunity for efficiency improvement that passes a cost-effectiveness test, assuming all efficiency opportunities that pass that test are adopted without regard to any market barriers or assumptions about how many people would actually choose to adopt them. For this study, cost-effectiveness is defined by the Participant Cost Test, which considers measures as cost-effective so long as the total lifetime cost savings to the energy consumer (based on retail energy costs) exceed the up-front initial efficiency measure investment. Measures are considered to pass the test whenever the benefit-cost ratio is greater than or equal to 1.0.

Economic potential was estimated for a 12-year period, from 2014 to 2025. Due to schedule and budget constraints, this study relies solely on existing available data, and did not include any new primary data collection. Whenever possible existing data from Delaware or the Mid-Atlantic region was relied on.

STUDY OVERVIEW

This section provides a brief overview of the study scope and approaches, with more detail provided in the sections below. The Phase I economic potential study included the following key components:

- A 12-year economic efficiency potential study for the period 2014-2025.
- An estimate of the economic efficiency potential for electricity, natural gas, and petroleum fuels.

[4] Petroleum fuels included oil #2, #4 and #6, propane and kerosene. All petroleum fuel potential was estimated in aggregate and is not provided for each individual fuel.

- Petroleum fuels included distillate (#2 and #4) and residual (#6) fuel oil, propane, and kerosene, and these were analyzed in aggregate rather than separately.

- An estimate of the economic potential for the residential, commercial (including institutional and government), and industrial sectors. The study was restricted to the buildings sector and does not include transportation efficiency.

The focus of Phase I was to estimate the *economic* efficiency potential. The economic efficiency potential includes all efficiency that is considered to be cost-effective from a Participant Cost Test perspective. It quantifies an upper-bound of efficiency savings if all cost-effective efficiency opportunities were captured when available. As such, it is a hypothetical upper limit of what could actually be captured with efficiency programs, ignoring the real world market barriers that often prevent people from adopting all cost-effective efficiency. The economic potential assumes 100% of all efficiency opportunities are captured. For measures that are not time discretionary, such as adding insulation to a building that is not undergoing any other renovations (hereinafter referred to as “retrofit” or “early retirement” opportunities), we assume these opportunities are captured evenly over the 12-year period. While in theory all these opportunities exist in 2014, constraints such as work force availability would limit the amount of these measures that could actually be captured in any given year. This results in the same cumulative potential savings by 2025, but evens out the annual results. This is more useful in that it reflects annual opportunities more in line with what could be considered during Phase II from actual efficiency programs. For time-dependent opportunities such as new construction or replacement on failure of equipment (hereinafter referred to as “market-driven” or “lost” opportunities), all measures are assumed installed at the time the opportunity is created.

The Phase I scope was limited in several important respects:

- Only considers economic potential, based on a Participant Cost Test
- Relies solely on existing available data, in some cases from outside Delaware
- Does not include fuel switching measures
- Does not include combined heat and power (CHP) measures
- Does not include demand response measures

The Methodology section below provides a detailed discussion of the methods and assumptions used in the analysis. The steps below lay out the basic methodological approach for assessing the economic efficiency potential.

- Identify the baseline energy sales forecasts for each fuel type, and disaggregate the forecasts by building type/segment and end-use
- Characterize the efficiency measures for their costs and savings

- Apply the measures to the potential study model and appropriate shares of disaggregated energy forecasts to analyze annual impacts
- Screen measures for cost-effectiveness in each install year of the 12-year study period, using the Participant Cost Test (a measure "passes" if its benefits exceed its costs)
- Remove any non-cost-effective measures in the years for which they are not cost-effective
- Adjust all interaction factors between measures to avoid double counting and rerun the subset of measures that pass the PCT.

FINDINGS

SECTOR-LEVEL RESULTS

This section provides sector-level and total results for each fuel type. The following sections provide more detailed results within each sector, at the end use and measure level.

Key findings include:

- Total electric economic potential is 4,091 GWh, representing 26.3% of the 2025 base case forecasted load.[5] If captured, this would result an average annual load *decrease* of 1.6% per year.
- Total natural gas economic potential is 8,234 billion Btu (BBtu), representing 19.6% of the 2025 base case forecasted load. If captured, this would result an average annual load *decrease* of 1.4% per year.
- Total petroleum fuels economic potential is 1,319 BBtu, representing 12.6% of the 2025 base case forecasted load. If captured, this would result an average annual load *decrease* of 0.9% per year.

Total economic potential by fuel is shown below in Figures 7 to 9. As shown in those figures, adopting all cost-effective measures in all Delaware buildings and factories would more than offset expected load growth through 2025, resulting in a downward trend in energy usage in the buildings sector in Delaware. How much of that can actually be captured cost-effectively with efficiency programs, and the costs of capturing it, have not been evaluated in this phase of the project.

[5] All electric energy (kWh) values sited in this report are at generation or point-of-purchase, and do not include line losses. See Appendix F (page 91) for the line loss factor used to convert from savings at the customer meter.

Figure 7. Electric Total Forecast and Economic Efficiency Potential by Sector

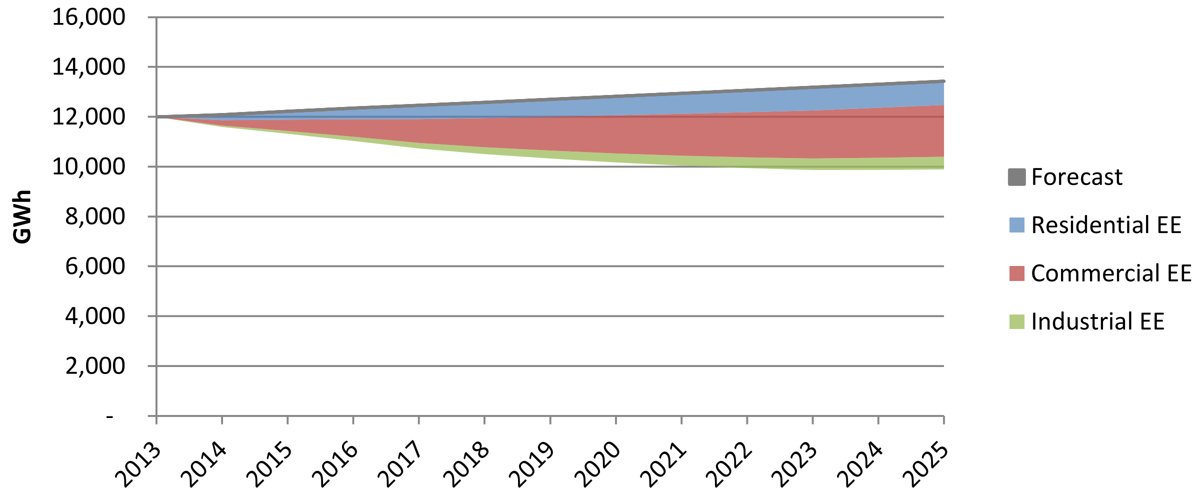


Figure 8. Natural Gas Forecast and Economic Efficiency Potential by Sector

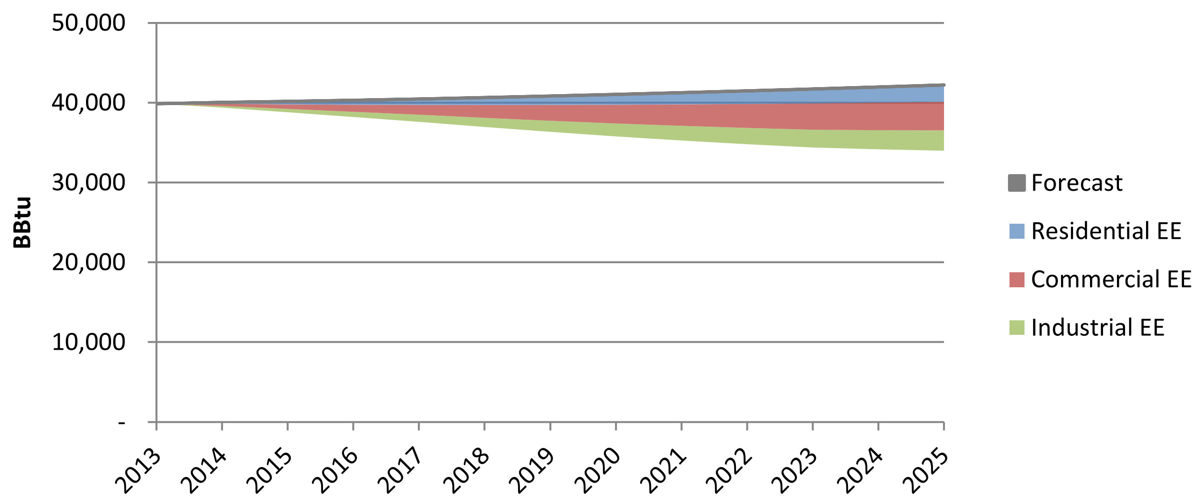
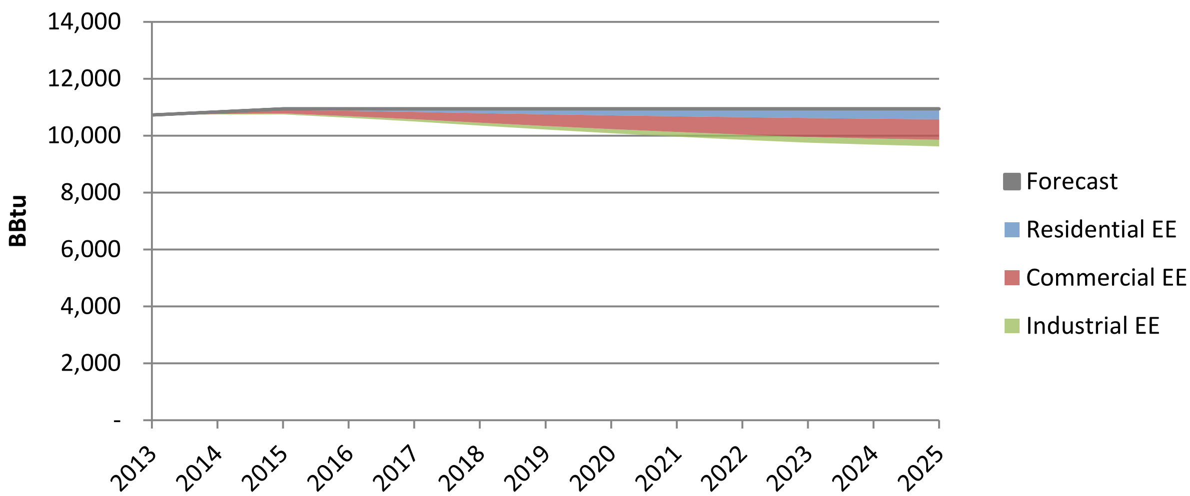


Figure 9. Petroleum Fuels Forecast and Economic Efficiency Potential by Sector



The analysis considers efficiency potential by sector, or customer class: residential, commercial (including institutional and government), and industrial. As shown in Figure 10 and Table 3, we find the 2025 cumulative potential greatest in the commercial sector, with 39.2%, 33.3% and 34.1% reductions in usage by 2025 for electricity, gas and petroleum fuels respectively.[6] The residential sector is the next highest at respective reductions of 18.0% (electric), 17.4% (gas) and 6.0% (petroleum). Finally, the industrial sector potential is estimated at 17.9% (electric), 13.4% (gas) and 8.6% (petroleum). The following sections provide a more detailed breakdown of each sector by end use and at the measure level.

[6] The 2025 "cumulative" potential means the total potential efficiency savings due to all efficiency measures installed or adopted during the 12-year study period, up to 2025, but not including the savings of measures that reached the end of their effective useful life prior to 2025.

Figure 10. Cumulative Savings Relative to Forecast (2025)

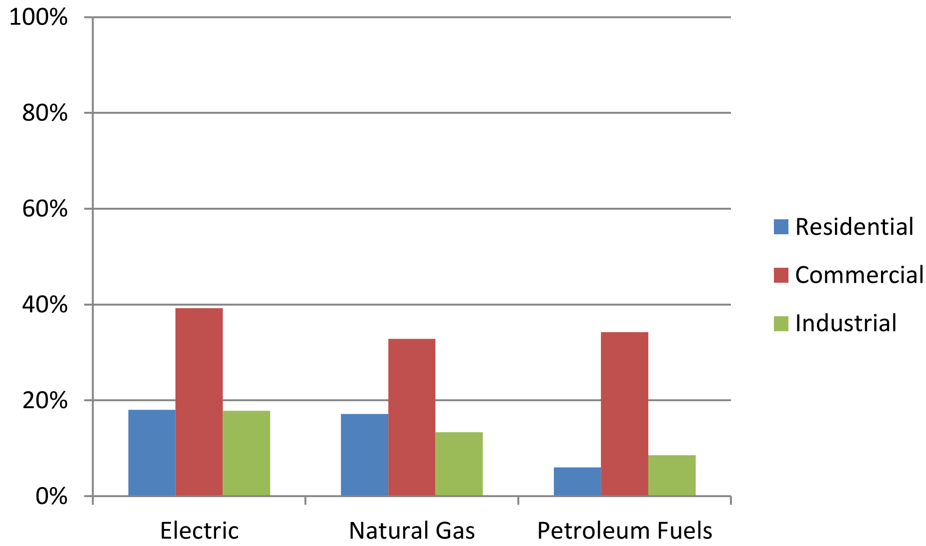


Table 3. Summary of Cumulative Efficiency Potential Relative to Forecast (2025)

	Forecast	Cumulative Savings	% of Forecast
Electric (GWh)			
Residential	5,284	952	18%
Commercial	5,292	2,076	39%
Industrial	2,848	509	18%
Total	13,424	3,537	26%
Natural Gas (BBtu)			
Residential	12,266	2,109	17%
Commercial	10,873	3,572	33%
Industrial	19,071	2,553	13%
Total	42,210	8,234	20%
Petroleum Fuels (BBtu)			
Residential	6,136	368	6%
Commercial	2,103	720	34%
Industrial	2,699	231	9%
Total	10,938	1,319	12%

If the total economic potential were hypothetically captured, it would produce $438 million in net benefits (in real 2013 $) to the Delaware economy. The benefit-cost ratio based on the

Participant Cost Test would be 4.01, implying that for every dollar invested in efficiency the economy would recoup 4.01 dollars in benefits. Total investment would be $146 million, with benefits to consumers (mostly energy bill savings) of $584 million. Table 4 shows the cumulative economic impacts through 2025, broken out by sector. Table 5 shows the net benefits for each fuel type within each sector.

Table 4. Summary of Cumulative Participant Costs and Benefits by Sector (2025)

Sector	Benefits (Million $)	Costs (Million $)	Net Benefits (Million $)	BCR
Residential	$194	$57	$137	3.39
Commercial	$322	$75	$247	4.30
Industrial	$68	$14	$54	4.95
Total	$584	$146	$438	4.01

Table 5. Summary of Cumulative Net Benefits* by Sector and Fuel (2025)

Sector	Net Electric Benefits (Million $)	Net Natural Gas Benefits (Million $)	Net Petroleum Fuel Benefits (Million $)	Total Net Benefits (Million $)
Residential	$114	$18	$6	$137
Commercial	$222	$20	$5	$247
Industrial	$34	$18	$2	$54
Total	$370	$55	$13	$438

* Net benefits are calculated as the sum of the present value of avoided retail energy costs and other resource savings, minus the present value of the upfront investment costs of the efficiency measures

The following sections provide more disaggregated details by sector, in particular showing how each major end use contributes to the sector level potential, and the top measures that offer the greatest opportunities.

RESIDENTIAL RESULTS

The residential sector accounts for 27% of the total electric potential. This reflects 952 GWh, which is 18% of the 2025 forecast.

Figure 11 shows how the electric energy (GWh) residential potential breaks out by major end use. As can be seen, water heating accounts for the greatest share of potential at 26%, followed by lighting at 20%, and refrigeration and cooling each at 16%. Table 6 shows the top residential measures and their contribution to the overall residential potential. Heat pump water heaters (<55 gallons) represent the largest single measure opportunity with 20% of the total residential potential (increased standards for larger heat pump water heaters are expected in 2015).

Figure 11. Residential Electric Economic Efficiency Potential by End Use 2025

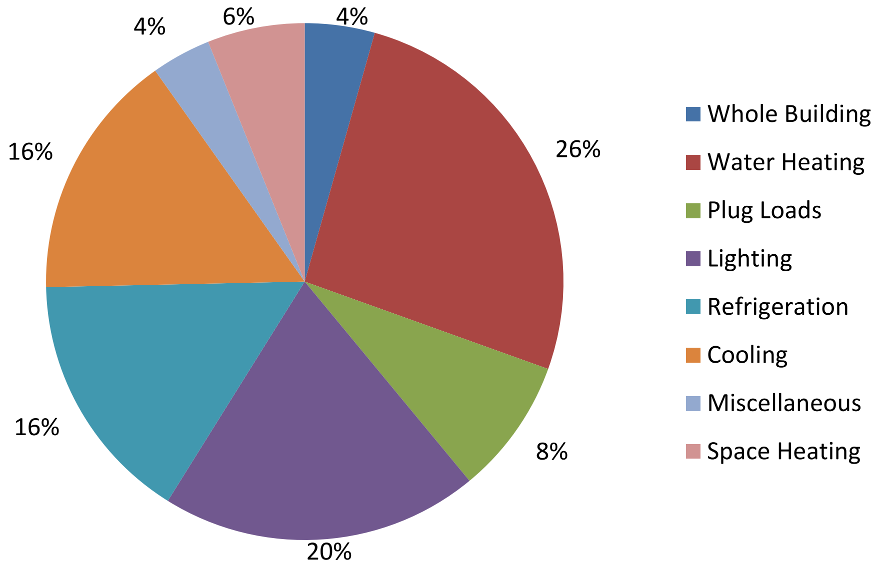


Table 6. Residential Electric Top-saving Measures 2025

Measure Name	Cumulative MWh 2025	Percent of Residential Sector Total	Participant BCR
Electric heat pump water heater <55gal	224,485	20.4%	4.13
Efficient Refrigerator Tier 2	113,381	10.3%	4.32
Duct Sealing, cooling	82,745	7.5%	2.35
Controlled power strip	73,842	6.7%	3.09
LED screw based Lamp <450 Lumens	71,967	6.5%	6.26
LED screw based lamp 450-1600 Lumens	65,590	6.0%	6.26
Enhanced behavior-based efficiency	48,109	4.4%	7.39
Efficient Central AC, ESTAR	44,387	4.0%	1.58
LED recessed downlight retail	43,324	3.9%	5.44
Pool Pump	40,974	3.7%	7.67
	808,804	73.4%	

The residential sector accounts for 26% of the total gas potential. This reflects 2,109 BBtu, which is 17% of the 2025 forecast.

Figure 12 shows how the gas residential potential breaks out by major end use. As is expected, virtually all gas savings potential comes from just two end uses: space and water heating, with being roughly equal at 51% and 49%, respectively. Table 7 shows the top residential measures and their contribution to the overall residential potential. The ENERGY

STAR furnace and the Condensing gas water heater (<55 gal) represent together account for nearly 60% of the entire residential gas potential.

Figure 12. Residential Natural Gas Economic Efficiency Potential by End Use 2025

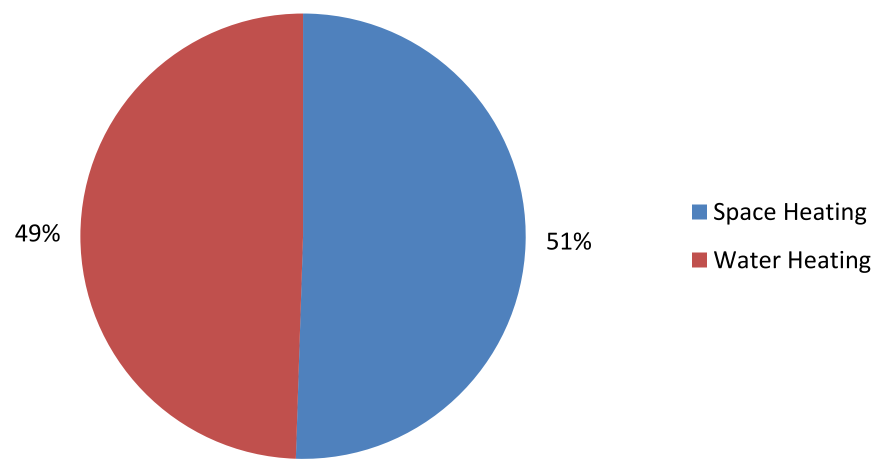


Table 7. Residential Natural Gas Top-saving Measures 2025

Measure Name	Cumulative BBtu 2025	Percent of Residential Sector Total*	Participant BCR
Gas Furnace, ESTAR	682	30.6%	5.47
Condensing Gas water heater <55gal	637	28.6%	1.20
Duct Sealing, gas	395	17.7%	18.16
Water Heating, petroleum fuels	339	15.2%	1.65
Gas Boiler, ESTAR	96	4.3%	3.67
Air Sealing, heating, gas	14	0.6%	1.93
Clothes Washer - Retail	10	0.4%	4.02
Clothes Washer - Early Replacement	4	0.2%	1.67
	2,177	97.6%	

* Sector total excluding increased gas usage due to waste heat adjustment for electric equipment.

The residential sector accounts for 28% of the total petroleum fuels potential. This reflects 368 BBtu, which is 6% of the 2025 forecast. Petroleum potential is overall relatively small because of the large availability of natural gas to the Delaware population, which is expected to gradually increase in the coming years.

Figure 13 shows how the petroleum fuels residential potential breaks out by major end use. As with the gas potential, space and water heating account for virtually all the potential, with space heating representing 84% of total residential potential. Table 8 shows the top residential measures and their contribution to the overall residential potential. Duct sealing for heating accounts for fully 61% of the entire residential electric potential.

Figure 13. Residential Petroleum Fuels Economic Efficiency Potential by End Use 2025

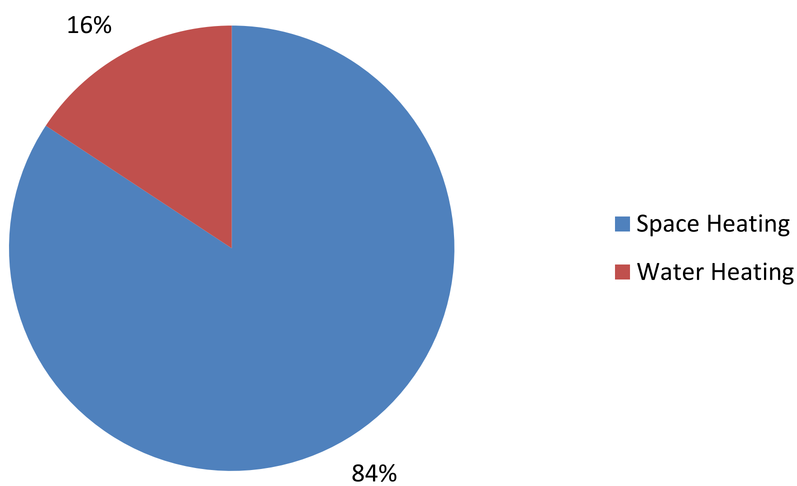


Table 8. Residential Petroleum Fuels Top-saving Measures 2025

Measure Name	Cumulative BBtu 2025	Percent of Residential Sector Total*	Participant BCR
Duct Sealing, Fossil Fuel heat	272	61.5%	18.16
Oil Furnace, ESTAR	102	23.1%	1.54
Water Heating, petroleum fuels	49	11.2%	1.65
Air Sealing, fossil fuels -Heat	10	2.3%	1.93
Clothes Washer - Retail	6	1.4%	4.02
Clothes Washer - Early Replacement	2	0.6%	1.67
	441	100.0%	

* Sector total excluding increased fuel usage due to waste heat adjustment for electric equipment.

COMMERCIAL RESULTS

The commercial sector accounts for 59% of the total electric potential. This reflects 2,076 GWh, which is 39% of the 2025 forecast.

Figure 14 shows how the electric energy (GWh) commercial potential breaks out by major end use. Interior lighting and cooling account for the greatest shares of potential, representing 28% and 26% respectively. The whole building end use accounts for 17% of the potential, nearly half of that from whole-building deep energy retrofits. Table 9 shows the top commercial measures and their contribution to the overall residential potential. High-efficiency lighting fixtures/design Tier III accounts for the largest savings at 14.5% of the entire residential electric potential.

Figure 14. Commercial Electric Economic Efficiency Potential by End Use 2025

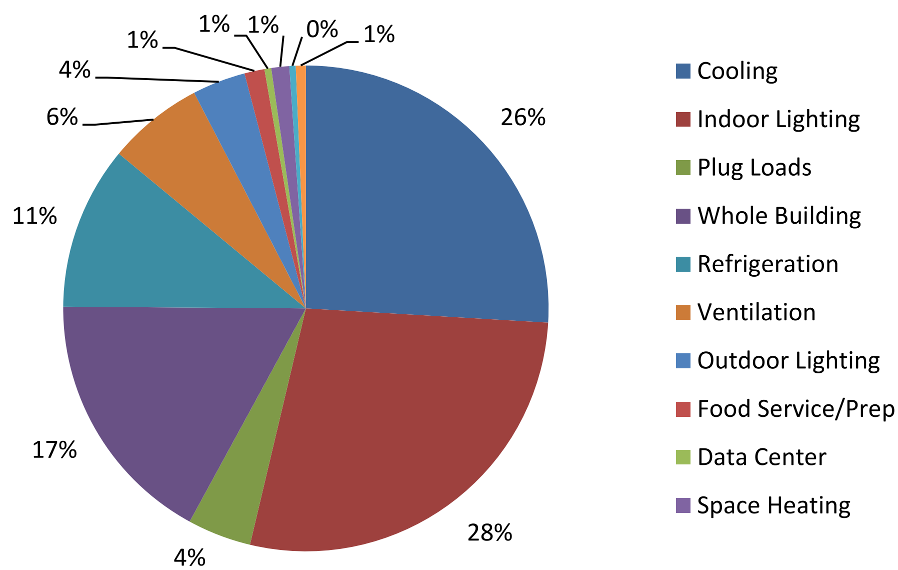


Table 9. Commercial Electric Top-saving Measures 2025

Measure Name	Cumulative MWh 2025	Percent of Commercial Sector Total	Participant BCR
HE lighting fixtures/design Tier III	347,345	14.5%	2.80
Deep Energy Retrofit - Electric	184,900	7.7%	9.71
High-efficiency small walk-in cooler	101,908	4.2%	20.81
Cool roof	97,291	4.1%	5.19
LED Recessed Fixture	93,016	3.9%	2.08
High-efficiency plug loads	92,368	3.9%	6.36
Retrocommissioning -Elec	81,840	3.4%	14.35
Integrated bldg design Tier I -Elec	78,200	3.3%	4.51
Opt unitary HVAC dist/control sys	78,012	3.3%	6.08
High-efficiency chillers Tier II	70,851	3.0%	2.93
	1,225,731	51.0%	

The commercial sector accounts for 43% of the total gas potential. This reflects 3,572 BBtu, which is 33% of the 2025 forecast.

Figure 15 shows how the gas commercial potential breaks out by major end use. Space heating accounts for the largest share at 69%, with the whole building end use at 21%. Table 10 shows the top commercial measures and their contribution to the overall commercial potential. Demand controlled ventilation provides the largest portion of savings at 26.5% of the entire commercial gas potential.

Figure 15. Commercial Natural Gas Economic Efficiency Potential by End Use 2025

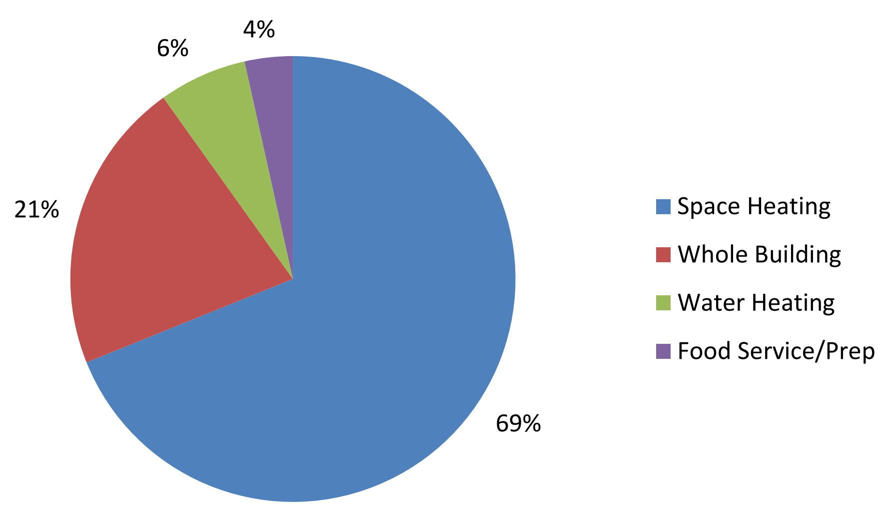


Table 10. Commercial Natural Gas Top-saving Measures 2025

Measure Name	Cumulative BBtu 2025	Percent of Commercial Sector Total*	Participant BCR
Demand controlled ventilation	1,066	26.5%	16.04
High-efficiency boiler	427	10.6%	1.41
Duct insulation and sealing, FF heat	393	9.8%	7.10
Deep Energy Retrofit -Fossil Fuel	308	7.7%	2.71
Demand controlled ventilation -Vent	259	6.4%	20.42
Retrocommissioning -Fossil Fuel	219	5.4%	4.57
Opt unitary HVAC dist/control sys	213	5.3%	6.08
High-eff built-up refrigeration	135	3.4%	3.24
Gas HE tank-type water heater	117	2.9%	8.10
Gas kitchen equipment, 3 meal	113	2.8%	12.91
	3,250	80.8%	

* Sector total excluding increased fuel usage due to waste heat adjustment for electric equipment.

The commercial sector accounts for 55% of the total petroleum fuels potential. This reflects 720 BBtu, which is 34% of the 2025 forecast. Petroleum potential is overall relatively small because of the large availability of natural gas in Delaware, which is expected to gradually grow in the coming years.

Figure 16 shows how the petroleum fuels commercial potential breaks out by major end use. As with the gas potential, space and water heating account for virtually all the potential, at 76% and 23% of total residential potential, respectively. Table 11 shows the top commercial measures and their contribution to the overall commercial potential. Half of the potential is provided by the top three measures: demand controlled ventilation (22%), high-efficiency boilers (16%), and duct insulation and sealing (14%).

Figure 16. Commercial Petroleum Fuels Economic Efficiency Potential by End Use 2025

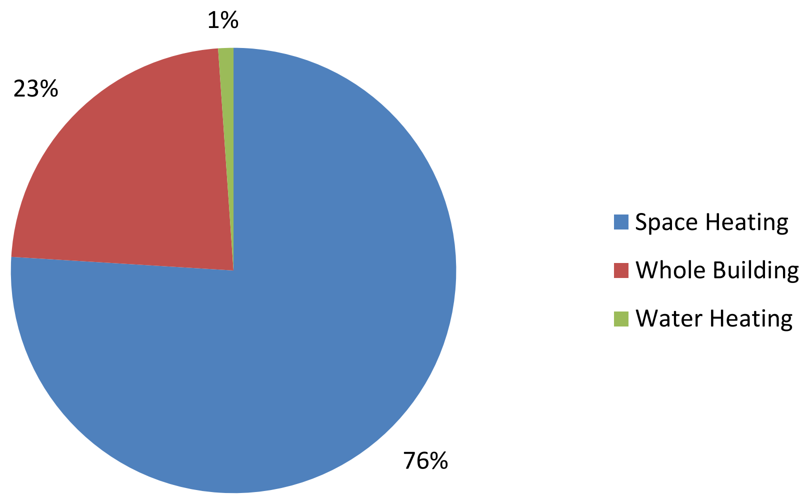


Table 11. Commercial Petroleum Fuels Top-saving Measures 2025

Measure Name	Cumulative BBtu 2025	Percent of Commercial Sector Total*	Participant BCR
Demand controlled ventilation -Heat	175	22.1%	16.04
High-efficiency boiler	129	16.3%	1.41
Duct insulation and sealing -FF Heat	109	13.8%	7.10
Deep Energy Retrofit - Fossil Fuel	66	8.3%	2.71
Retrocommissioning -Fossil Fuel	45	5.7%	4.57
Demand controlled ventilation -Vent	43	5.4%	20.42
Opt unitary HVAC dist/control sys	35	4.4%	6.08
Integrated bldg design Tier I -FF	28	3.5%	1.30
High-eff built-up refrigeration	22	2.8%	3.24
Blow-down heat recovery	21	2.7%	5.20
	673	85.0%	

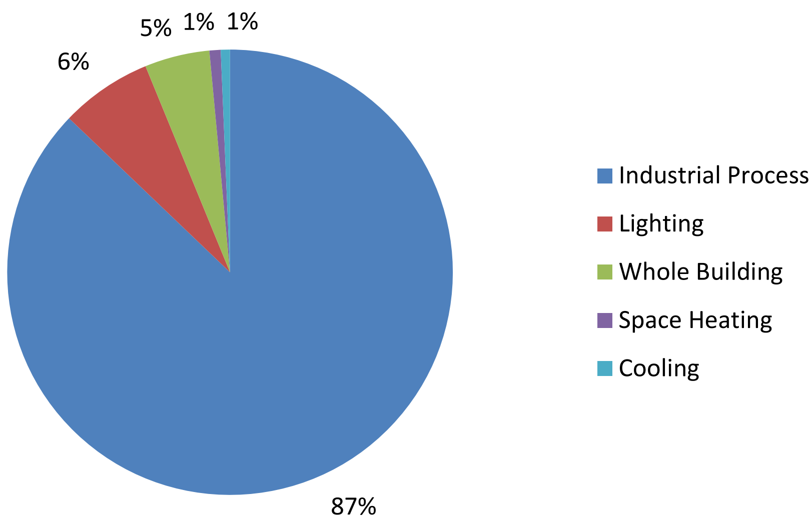
* Sector total excluding increased fuel usage due to waste heat adjustment for electric equipment.

INDUSTRIAL RESULTS

The industrial sector accounts for 14% of the total electric potential. This reflects 509 GWh, which is 18% of the 2025 forecast. The industrial sector was estimated as a whole, and includes all manufacturing and other industrial energy use in Delaware, including both process and facility loads. Results are not available by specific industrial sector.

Figure 17 shows how the electric energy (GWh) industrial potential breaks out by major end use. Process energy represents the greatest opportunity for efficiency, at 87% of the total industrial potential. Lighting and the whole building end use account for most of the remaining potential. Process end use opportunities were estimated in aggregate, and as such we do not show individual top technologies driving the potential.

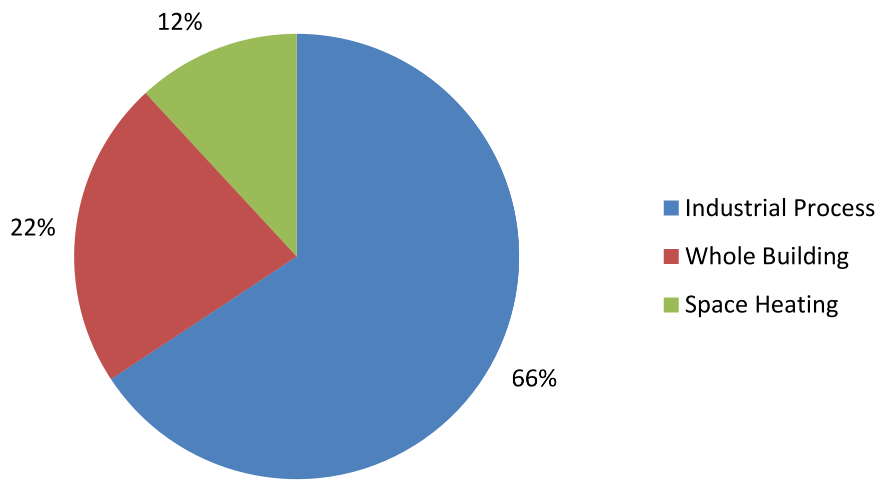
Figure 17. Industrial Electric Economic Efficiency Potential by End Use 2025



The industrial sector accounts for 31% of the total gas potential. This reflects 2,553 BBtu, which is 13% of the 2025 forecast.

Figure 18 shows how the gas industrial potential breaks out by major end use. As is expected, most gas savings potential comes from just two end uses: process and non-process space heating, with process accounting for the largest share at 66%.

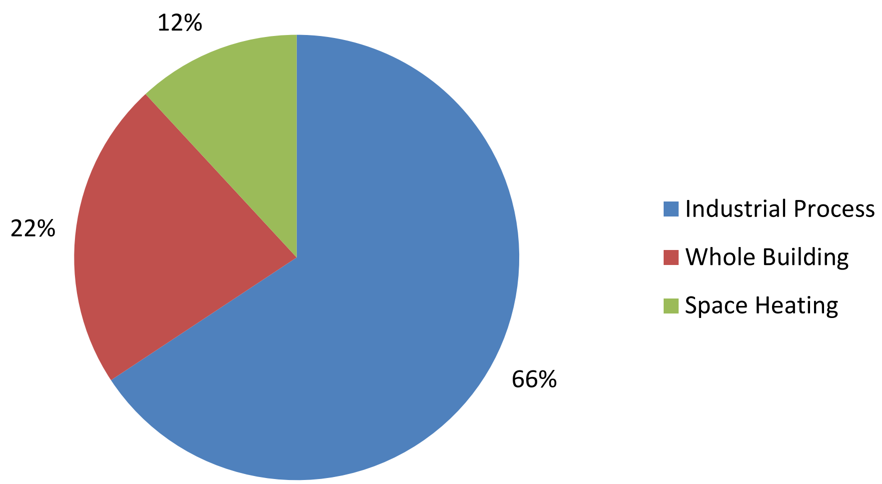
Figure 18. Industrial Natural Gas Economic Efficiency Potential by End Use 2025



The industrial sector accounts for 18% of the total petroleum fuels potential. This reflects 231 BBtu, which is 9% of the 2025 forecast. Petroleum potential is overall relatively small because of the relatively large availability of natural gas in Delaware.

Figure 19 shows how the petroleum commercial potential breaks out by major end use. Industrial process accounts for 66% of the total petroleum fuels potential.

Figure 19. Industrial Petroleum Fuels Economic Efficiency Potential by End Use 2025



EFFICIENCY SUPPLY CURVES

Below are efficiency supply curves by fuel type for the total 12-year economic potential. Supply curves graph the total amount of savings potential in 2025 (x-axis) vs. the participant benefit-cost ratio (y-axis). The benefit-cost ratio is based on the Participant Cost Test (PCT), as described in greater detail below in the Methodology section.

This use of the benefit-cost ratio (BCR) for the y-axis differs from typical supply curves that often graph the potential against a levelized cost of efficiency in terms of $/kWh or $/Btu. The Participant Cost Test BCR more directly indicates the cost-effectiveness of the measures that would the levelized cost of energy saved, which ignores other consumer benefits such as operation and maintenance and water savings.

The efficiency supply curves graphically provide a sense of where the savings come from and how much potential is available from what sectors and end uses, and at different levels of cost-effectiveness. The Y-axis is the participant benefit-cost ratio, with the X-axis representing the total cumulative potential savings in 2025. All of the efficiency shown on the supply curves is cost-effective, with a benefit-cost ratio of at least 1.0. As can be seen, the efficiency opportunities are widely intermixed across sectors and by BCR, and the vast majority of efficiency opportunities have BCRs well above 1.0. For electric efficiency, the commercial opportunities generally provide larger savings opportunities with higher BCRs than residential, while the industrial potential is largely concentrated in the process end use. For natural gas and petroleum fuels the potential is distributed mainly across space heating, water heating, and industrial process, with varying cost-effectiveness.

Figure 20. Economic Electric Energy Efficiency Supply Curve by Sector and End Use

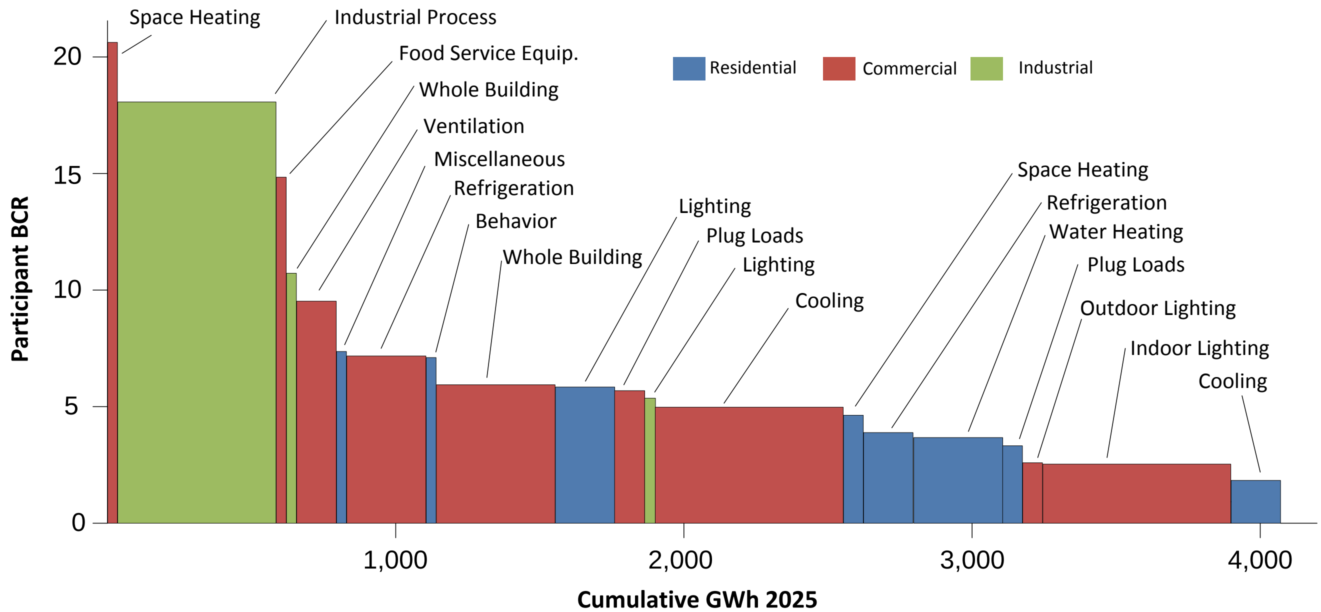


Figure 21. Economic Natural Gas Energy Efficiency Supply Curve by Sector and End Use

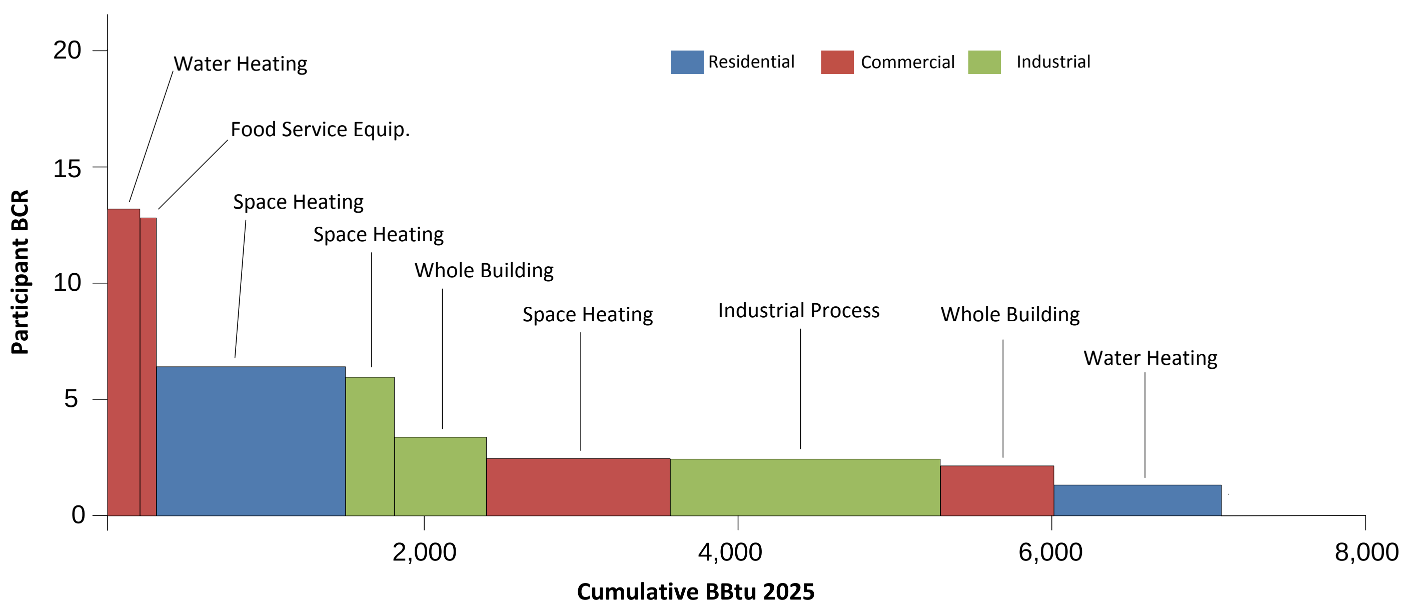
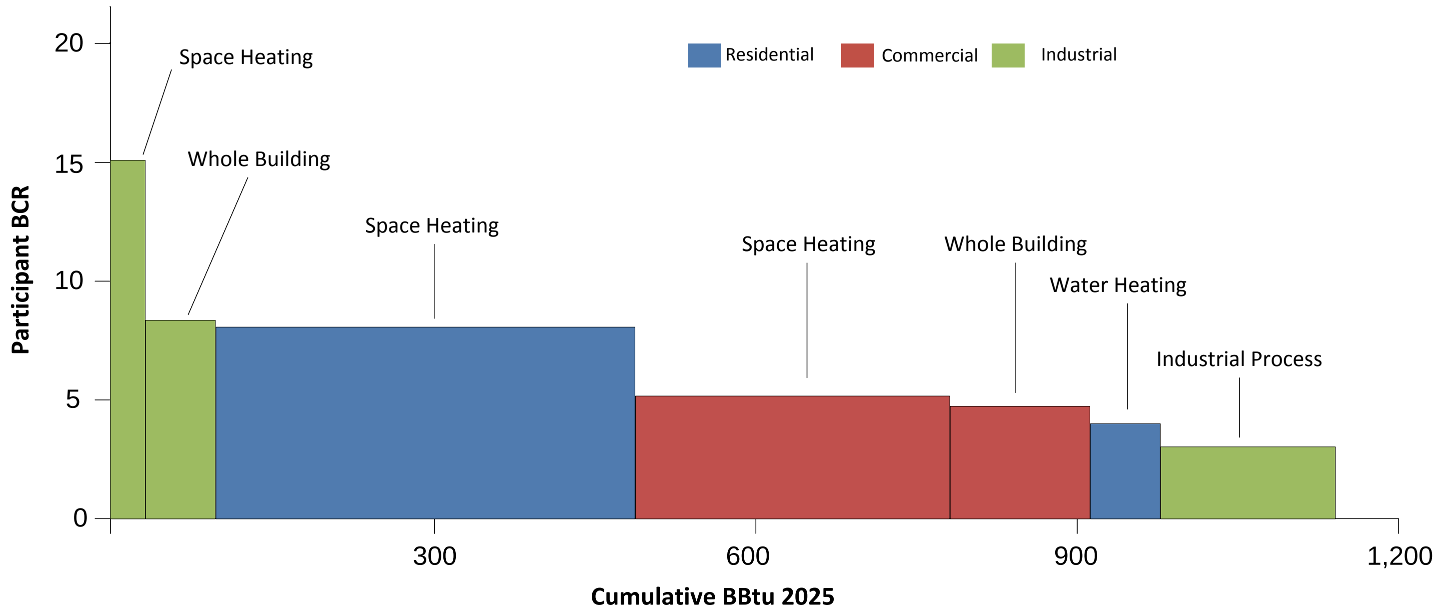


Figure 22. Economic Petroleum Fuel Energy Efficiency Supply Curve by Sector and End Use



METHODOLOGY

METHODOLOGY OVERVIEW

This section provides a brief overview of our approach to the analysis. The subsequent sections provide more detailed descriptions of the analysis inputs and the analysis methodology.

The economic energy efficiency potential analysis involves the following steps:

- Assess and adjust energy forecasts for any known codes and standards and estimate naturally occurring efficiency adoption to ensure it properly reflects consistent base case assumptions about customers and end uses.
- Disaggregate adjusted energy forecasts by sector (residential, commercial, industrial), by market segment (e.g., building types), and end uses (e.g., lighting, cooling, etc.).
- Characterize efficiency measures, including estimating costs, savings, lifetimes, and share of end use level forecasted usage for each market segment.
- Build up savings by measure/segment based on measure characterizations calibrated to total energy usage.
- Account for interactions between measures, including savings adjustments based on other measures as well as ranking and allocating measures when more than one measure can apply to a particular situation.
- Run the stock adjustment model to track existing stock and new equipment purchases to capture the eligible market for each measure in each year.
- Run the efficiency potential model to estimate total potential for each measure/segment/market combination to produce potential results.
- Screen each measure/segment/market combination for cost-effectiveness. Remove failing measures from the analysis and rerun the model to re-adjust for measure interactions.

Annual energy sales forecasts were developed for each energy type (electricity, natural gas, and petroleum fuels), and for each sector (residential, commercial, industrial), for the 12-year study period. Electric and natural gas forecasts were provided by Delaware utilities and cooperatives, as further describe below. The petroleum fuels forecast was based on data from the U.S. Energy Information Administration (EIA). We then disaggregated the sales forecasts by end use and building type in order to apply each efficiency measure to the appropriate segment of energy use. This study applied a top-down analysis of efficiency potential relative to the energy sales disaggregation for each sector, merged with a bottom-up measure level analysis of costs and savings for each applicable technology.

The efficiency economic potential estimated savings from a wide range of efficiency measures (i.e., efficiency technologies and practices). The study analyzed both technologies that are commercially available now and emerging technologies considered likely to become commercially available over the study horizon.

The study applied a Participant Cost Test (PCT) to determine measure cost-effectiveness. Efficiency measure costs for market-driven measures represent the incremental cost from a standard baseline (non-efficient) piece of equipment or practice to the high efficiency measure. For retrofit markets the full cost of equipment and labor was used because the base case is assumed to be no action on the part of the building owner. Measure benefits are driven primarily by customer lifetime energy bill savings, but also include other benefits associated with the measures, including water savings, operation and maintenance savings, and other non-energy benefits where readily identified and quantified. The energy impacts may include multiple fuels and end uses. For example, efficient lighting reduces waste heat, which in turn reduced the cooling load, but increases the heating load, all of which are accounted for in the estimation of the measure's costs and benefits over its lifetime.

There are two aspects to electric efficiency savings: annual energy and coincident peak demand impacts. The former refers to the reductions in actual energy usage, which typically drive the greatest share of electric economic benefits as well as emissions reductions. However, because it is difficult to store electricity the total reduction in the system peak load is also an important impact. Power producers need to ensure adequate capacity to meet system peak demand, even if that peak is only reached a few hours each year. As a result, substantial economic benefits can accrue from reducing the system peak demand, even if little energy and emissions are saved during other hours. For this study, we do not quantify the coincident system peak impacts. This was not included in Phase I because the focus was on participant economics, and it would be difficult to accurately model the peak demand contributions for each building and what the economic benefits associated with them might be.[7] However, the average retail rates used to assess the benefits of electric energy savings include the costs of both energy (kWh) and peak demand charges (kW-year).

For the economic potential, we generally assumed that all cost-effective measures would be immediately installed for market-driven measures such as for new construction, major renovation, and natural replacement ("replace on burnout"). For retrofit measures we generally assumed that resource constraints (primarily contractor availability) would limit the rate at which retrofit measures could be installed, depending on the measure, but that all or nearly all efficiency retrofit opportunities would be realized over the 12-year period. This results in smoother and lower estimates of retrofit potential in the early years, but provide a more realistic

[7] Large commercial and industrial customers typically pay both an energy charge and a billed peak demand charge each month. However, to determine the impact of an efficiency measure in every month on a hypothetical customers bill requires a complete modeling of each customer's likely hourly usage and how that coincides with the hourly savings from each measure. This was beyond the Phase I scope of this project. For participant economics we relied on average annual revenue collected per unit of energy sold for each fuel.

ramping up over time that would likely be reflected in any actual efficiency plans Delaware chooses to adopt.

ENERGY FORECASTS

Electric Forecast

The electric forecast was developed primarily from the individual utility forecasts provided by Delmarva Power, Delaware Electric Cooperative, and Delaware Municipal Electric Corporation.[8] Reported sales categories aligned with traditional utility categories, which closely mirror the three customer sectors that were analyzed. In some cases, energy loads were aggregated to the sector level using standard conventions (e.g., street lighting energy use is included in the commercial sector). The electric base case forecast represents a weather normalized forecast, and reflects an estimated average annual growth rate of 1.01% per year. Table 12 shows the electric forecast, by sector and year. This reflects electric usage at the meter level, in other words, not including line losses from the generator to the point of use.

Table 12. Electric Sales Forecast by Sector and Year (GWh)

Sector	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Residential	4,510	4,586	4,661	4,729	4,798	4,869	4,942	5,016	5,090	5,172	5,256	5,338
Commercial	4,835	4,877	4,917	4,954	4,991	5,029	5,068	5,108	5,148	5,190	5,233	5,276
Industrial	2,735	2,754	2,768	2,776	2,787	2,801	2,809	2,815	2,822	2,820	2,814	2,810
Total	12,080	12,218	12,346	12,458	12,576	12,698	12,818	12,938	13,060	13,182	13,303	13,424

Natural Gas Forecast

The natural gas forecast was developed using both forecasts provided by Chesapeake Utilities[9] and from the U.S. Energy Information Administration (EIA).[10] As only Chesapeake Utilities provided a natural gas forecast, the EIA data for Delaware was leveraged to estimate sales for other natural gas providers, i.e., Delmarva and Eastern Shore. Eastern Shore serves primarily as a transmission provider for local distribution companies but does provide direct sales to select industrial customers. While the EIA does report commercial and industrial sales for Eastern Shore, only the industrial sales were explicitly used as the commercial were reportedly already included in the forecast provided directly by Chesapeake Utilities. As the Chesapeake Utilities natural gas forecast was only provided through 2017, the 5-year average forecast growth rate (2013-2017) was assumed to project sales for the remainder of the analysis period. Similarly, EIA

[8] D. Pirtle, Delmarva Power, personal communication, March 8, 2013; M. Nielson, Delaware Electric Cooperative, personal communication, March 30, 2013; S. Lynch, Delaware Municipal Electric Corporation, personal communication, March 20, 2013.

[9] S. Hardy, Chesapeake Utilities, personal communication; February 22, 2013.

[10] U.S. Energy Information Administration, Natural Gas Annual Respondent Query System (EIA-176 Data Through 2011), November 2012

data was leveraged to project Delmarva natural gas sales by using the 4-year average growth rate (2008-2011) applied to reported 2011 sales. Due to the volatility of historic industrial sector natural gas sales of Eastern Shore, driven primarily by the 2009 closure and 2011 reopening of the Delaware City Refinery, the sales forecast assumes annual sales consistent with 2011 sales for the analysis period.

The gas base case forecast represents a weather normalized forecast, and reflects an estimated average annual growth rate of 0.49% per year. Table 13 shows the gas forecast, by sector and year.

Table 13. Natural Gas Sales Forecast by Sector and Year (BBtu)

Sector	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Residential	10,557	10,711	10,869	11,028	11,188	11,348	11,508	11,668	11,828	11,988	12,149	12,309
Commercial	9,638	9,838	10,038	10,244	10,458	10,674	10,891	11,109	11,329	11,551	11,774	11,998
Industrial	19,837	19,606	19,387	19,181	18,987	18,804	18,631	18,468	18,314	18,169	18,032	17,903
Total	40,032	40,155	40,295	40,454	40,634	40,826	41,030	41,245	41,472	41,708	41,955	42,210

Petroleum Fuels Forecast

EIA data on current petroleum consumption in Delaware was used with an assumed consumption growth rate to develop the petroleum fuels forecast.[11] A 1% annual growth rate has been assumed for years 2014 and 2015. From 2016 forward, the analysis assumes petroleum fuels sales remain static at the projected 2015 levels to reflect the on-going significant displacement of petroleum fuels by the expansion of natural gas service in the state.

The petroleum fuels base case forecast represents a weather normalized forecast, and reflects an estimated average annual growth rate of 0.09% per year. Table 14 shows the gas forecast, by sector and year.

Table 14. Petroleum Fuels Sales Forecast by Sector and Year (BBtu)

Sector	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Residential	6,208	6,270	6,270	6,270	6,270	6,270	6,270	6,270	6,270	6,270	6,270	6,270
Commercial	2,174	2,195	2,195	2,195	2,195	2,195	2,195	2,195	2,195	2,195	2,195	2,195
Industrial	2,449	2,473	2,473	2,473	2,473	2,473	2,473	2,473	2,473	2,473	2,473	2,473
Total	10,830	10,938	10,938	10,938	10,938	10,938	10,938	10,938	10,938	10,938	10,938	10,938

[11] U.S. Energy Information Administration, Adjusted Sales of Distillate Fuel Oil by End Use, November 30, 2013; U.S. Energy Information Administration, Adjusted Sales of Residual Fuel Oil by End Use, November 30, 2013; U.S. Energy Information Administration, Adjusted Sales of Kerosene by End Use, November 30, 2013; U.S. Energy Information Administration, State Profiles and Energy Estimates, "Table F12: Liquefied Petroleum Gases Consumption Estimates," 2011

Forecast Disaggregation by Segment and End Use

The commercial, industrial, and residential sales disaggregations draw upon many sources, and the discussion that follows is not an exhaustive description of all sources employed or steps in the analysis. The industrial disaggregation is primarily based on the EIA Manufacturing Energy Consumption Survey (MECS) 2010, assuming the "South" census region (MECS data are only available for the four major census regions).[12] The commercial disaggregation relies on a number of sources. First, total forecasted energy sales are divided across building types using data from Optimal Energy's recent Energy Efficiency and Renewable Resource Potential in New York State study. Unfortunately, reliable data specific to Delaware was not available, so data for Long Island, NY has been used as a proxy. Next, data from the recent Pennsylvania Statewide Commercial & Industrial End Use & Saturation Study was used to develop the electric disaggregation at the end-use level.[13] While a similar study was recently completed for Delaware, that study did not provide estimates of energy-use intensities that would support the disaggregation. The commercial natural gas and petroleum fuels end-use break-outs were estimated using data from the EIA 2003 Commercial Buildings Energy Consumption Survey (CBECS)[14] The residential building type and end-use disaggregation was developed using data from the EIA 2009 Residential Energy Consumption Survey (RECS),[15] the most recent Annual Community Survey from the US Census Bureau,[16] and the EIA 2013 Annual Energy Outlook.[17] Finally, relative changes in end-use distribution over the analysis period were adapted from the EIA 2013 Annual Energy Outlook.

Sales were further disaggregated into sales for new construction and renovated spaces and those for existing facilities. New construction activity for commercial and industrial facilities was estimated using national projections of new additions and surviving square footage from the EIA 2013 Annual Energy Outlook and assuming simple sector-wide energy use intensities. Residential new construction was projected assuming the 7-year average annual growth rate (1995-2001) in housing units for Delaware from the U.S. Census Bureau Building Permits Survey.[18] This period was assumed to reflect stable growth in housing starts before the housing boom and bust of the mid to late 2000s. Growth in number of housing units was translated to energy sales using average electric/fuel consumption per housing unit estimated from EIA 2009

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[12] U.S. Energy Information Administration, Manufacturing Energy Consumption Survey, "Table 5.5 End Uses of Fuel Consumption, 2010," March 2013

[13] Nexant, Pennsylvania Statewide Commercial & Industrial End Use & Saturation Study, April 18, 2012

[14] U.S. Energy Information Administration, Commercial Buildings Energy Consumption Survey, "Table E7A. Natural Gas Consumption (Btu) and Energy Intensities by End Use for All Buildings, 2003," September 2008

[15] U.S. Energy Information Administration, Residential Energy Consumption Survey, "Table CE4.4 Household Site End-Use Consumption by Fuel in the South Region, Totals, 2009," August 2011

[16] U.S. Census Bureau, 2007-2011 American Community Survey, "DP04 Selected Housing Characteristics"

[17] U.S. Energy Information Administration, Annual Energy Outlook 2013, "Table 4. Residential Sector Key Indicators and Consumption," April 2013.

[18] U.S. Census Bureau Building Permits Survey, "Table 2au. New Privately Owned Housing Units Authorized Unadjusted Units for Regions, Divisions, and States," 1995-2012

Residential Energy Consumption Survey. Finally, all buildings are assumed to be on a 25-year renovation cycle. In other words, 4% of total energy sales are assumed to be available for renovation measure opportunities annually.

Appendix B, page 42, shows the disaggregated annual energy forecasts. In all cases, the available forecast data relied upon was either not developed with (or the data was not available to understand) detailed end-use modeling and explicit assumptions about future codes and standards, changes in baseline practices, major shifts among fuels (e.g., driven by electric vehicles). As a result, we assume the forecasts represent the best estimate of future weather normalized loads and reflect assumptions about future baselines and codes and standards consistent with our analysis at the measure level.

MEASURE CHARACTERIZATION

The first process in developing measure characterizations is to define an initial list of measures to consider. This list was developed and qualitatively screened for appropriateness in consultation with DNREC and other Stakeholders. The final list of measures considered in the analysis is shown with their characterizations in Appendix D, page 49, which also shows in which markets each measure was considered.

A total of 188 measures were included and characterized for up to three applicable markets (new construction/renovation, natural replacement, and retrofit). This is important because the costs and savings of a given measure can vary depending on the market it is applied to. For example, a retrofit or early retirement of operating but inefficient equipment entails covering the costs of entirely new equipment and the labor to install it and dispose of the old equipment. For new construction or other market-driven opportunities, installing new high efficiency equipment may entail only the incremental cost difference between a standard efficiency piece of equipment and the high efficiency one, as other labor and capital costs would be incurred in either case. Similarly, on the savings side, retrofit measures can initially save more when compared to older existing equipment, while market-driven measure savings reflect only the incremental savings over current standard efficiency purchases. For retrofit measures, often we model a baseline efficiency shift at the time when the retrofit measure being replaced is assumed to have needed to be replaced anyway.

For each measure, in addition to separately characterizing them by market, we also separately analyze each measure/market combination for each building segment (e.g., single vs. multifamily; office vs. retail vs. hospital, etc.). The result is that we modeled 2,374 distinct measure/market/segment permutations for each year of the analysis.

Measure Data

The overall potential model relies on a top-down approach that begins with the forecast and disaggregates it into loads attributable to each possible measure, as described in the next section. In general, measure characterizations include defining, for each combination of measure, market, and segment, the following characteristics:

- Measure lifetime (both baseline and high efficiency options if different)
- Measure savings (both baseline and high efficiency options)
- Measure cost (incremental or full installed depending on market)
- O&M impacts (both baseline and high efficiency options if different)
- Water impacts (both baseline and high efficiency options if different)

Savings

For each technology, we estimate the energy usage of baseline and high efficiency measures based primarily on engineering analysis. We rely heavily on the Delaware Technical Reference Manual (TRM), as well as the Mid-Atlantic TRM, for measure savings for those measures covered by these documents. For more complex measures not addressed by the TRMs engineering calculations are used based on the best available data about current baselines in Delaware and the performance of high efficiency equipment or practices. Delaware baseline studies completed in 2012 for the residential and commercial-industrial sectors, were drawn on to identify baseline efficiency levels and practices wherever possible.[19] Because of budget and time constraints the scope did not include any building simulation modeling or other sophisticated engineering approaches to establishing detailed, weather normalized savings.

Costs

Measure costs were drawn from Optimal Energy's measure characterization database when no specific Delaware costs were available. These costs have been developed over time, and are continually updated with the latest information, including a recent update for an ongoing potential study in New York State. Major sources include the Delaware and Mid-Atlantic TRMs, baseline studies, incremental cost studies, direct research into incremental costs, and other analyses and databases that are publicly available.

Lifetimes

As with measure costs, lifetimes are drawn from Optimal's measure characterization database. These have been developed over time, and were revised for this study based on the Delaware and Mid-Atlantic TRMs.

Operations and Maintenance

Operation and maintenance (O&M) impacts are those other than the energy costs of operations. They represent, for example, things like replacement lamp purchases for new high efficiency fixtures, or changes in labor for servicing high-efficiency vs. standard-efficiency measures. High efficiency equipment can often reduce O&M costs because of higher quality components that require less-frequent servicing. On the other hand, some high efficiency

[19] See Appendix E for full citations to all referenced documents.

technologies require enhanced servicing, or have expensive components that need to be replaced prior to the end of the measure's lifetimes. For most measures, O&M impacts are very minimal, as many efficient and baseline technologies have the same O&M costs over time. Where they are significant, we estimate them based on our engineering and cost analyses, the Delaware and Mid-Atlantic TRMs, and other available data.

Additional aspects of measure characterization are more fully described below in the potential analysis section, along with other factors that merge the measure level engineering data with the top-down forecast of applicable loads to each measure.

ECONOMIC POTENTIAL ANALYSIS

Top-Down Approach

The general approach for this study, and for all sectors, is "top-down" in that the starting point is the actual forecasted loads for each fuel and each sector, which are then broken down into loads attributable to individual building equipment. In general terms, the top-down approach starts with the energy sales forecast and disaggregation and determines the percentage of the applicable end-use energy that may be offset by the installation of a given efficiency measure in each year. This contrasts with a "bottom-up" approach in which a specific number of measures are assumed installed each year.

Various measure-specific factors are applied to the forecasted building-type and end-use sales by year to derive the potential for each measure for each year in the analysis period. This is shown below in the following central equation:

Measure Savings	=	Segment/ End-use /year kWh Sales	x	Applicability Factor	x	Feasibility Factor	x	Turnover Factor (replace-ment only)	x	Not Complete Factor (retrofit only)	x	Savings Fraction	x	Net Penetration Rate

Where:

- **Applicability** is the fraction of the end-use energy sales (from the sales disaggregation) for each building type and year that is attributable to equipment that could be replaced by the high-efficiency measure. For example, for replacing office interior linear fluorescent lighting with a higher efficiency LED technology, we would use the portion of total office building interior lighting electrical load consumed by linear fluorescent lighting. The main sources for applicability factors at the Delaware and Pennsylvania baseline studies.
- **Feasibility** is the fraction of end-use sales for which it is technically feasible to install the efficiency measure. Numbers less than 100% reflect engineering

or other technical barriers that would preclude adoption of the measure. Feasibility is not reduced for economic or behavioral barriers that would reduce penetration estimates. Rather, it reflects technical or physical constraints that would make measure adoption impossible or ill advised. An example might be an efficient lighting technology that cannot be used in certain low temperature applications. The main sources for feasibility factors are the Delaware baseline studies and engineering judgment.

- **Turnover** is the percentage of existing equipment that will be naturally replaced each year due to failure, remodeling, or renovation. This applies to the natural replacement ("replace on burnout") and renovation markets only. In general, turnover factors are assumed to be 1 divided by the baseline equipment measure life (e.g., assuming that 5% or 1/20th of existing stock of equipment is replaced each year for a measure with a 20-year estimated life).
- **Not Complete** is the percentage of existing equipment that already represents the high-efficiency option. This only applies to retrofit markets. For example, if 30% of current single family home sockets already have compact fluorescent lamps, then the not complete factor for residential CFLs would be 70% (1.0-0.3), reflecting that only 70% of the total potential from CFLs remains. The main sources for not complete factors are the Delaware baseline studies, and the findings of other baseline and potential studies.
- **Savings Fraction** represents the percent savings (as compared to either existing stock or new baseline equipment for retrofit and non-retrofit markets, respectively) of the high efficiency technology. Savings fractions are calculated based on individual measure data and assumptions about existing stock efficiency, standard practice for new purchases, and high efficiency options.
    - **Baseline Adjustments** adjust the savings fractions downward in future years for early-retirement retrofit measures to account for the fact that newer, standard equipment efficiencies are higher than older, existing stock efficiencies. We assume average existing equipment being replaced for retrofit measures is at 60% of its estimated useful life.
- **Annual Net Penetrations** are the difference between the base case measure penetrations and the measure penetrations that are assumed for an economic potential. For the economic potential, it is assumed that 100% penetration is captured for all markets, with retirement measures generally being phased in and spread out over time to reflect resource constraints such as contractor availability.

The product of all these factors results in total potential for each measure permutation. Costs are then developed by using the "cost per energy saved" for each measure applied to the total savings produced by the measure. The same approach is used for other measure impacts, e.g., operation and maintenance savings.

Cost-Effectiveness Analysis

This study uses the Participant Cost Test (PCT) as the basis for excluding non-cost-effective measures from economic potential. The PCT test includes the following costs and benefits:

Costs

- Measure incremental cost (or full cost for early-retirement retrofit)
- Increased alternative energy usage (e.g., increased gas usage associated with an electric efficiency measure)
- Operation & Maintenance costs (e.g., more costly or frequent component replacement or maintenance costs)
- Early-retirement retrofit deferred replacement credit (e.g., the reduction in future costs resulting from early retiring measures and permanently shifting the capital investment cycle)
- Any increased water usage.

Benefits

- Avoided retail energy costs, based on average retail costs per unit for each fuel
- Water savings
- Operation & Maintenance savings
- Non-energy benefits associated with measures.

Average Retail Rates

Delaware 2011 average retail rates for electricity, natural gas, distillate fuel oil, residual fuel oil, and propane were determined by sector from the EIA State Energy Data System (SEDS).[20] The EIA estimates retail rates by dividing estimated utility revenue by estimated energy sales. Retail rates for each fuel were projected through the analysis period assuming growth rates for the "South Atlantic" region from the EIA's 2013 Annual Energy Outlook.[21] Retail rates for the aggregated petroleum fuels were determined by weighting the individual fuel rates by their relative share of the projected 2013 fuel sales from the sales forecast on a Btu basis. Appendix C, page 48, shows the average retail rates, by fuel, sector and year.

[20] U.S. Energy Information Administration, Electric Power Annual - Form EIA-861, "Average Price by State by Provider 1990-2011," October 1, 2012; U.S. Energy Information Administration, State Profile and Energy Estimates, April 18, 2013.

[21] U.S. Energy Information Administration, Annual Energy Outlook 2013, "Table 3.3 Energy Prices by Sector and Source – South Atlantic," April 2013.

Estimating Economic Potential

The above central equation, along with all the data inputs, produces the measure-level potential, with the economic potential being limited to cost-effective measure installs. However, the total economic potential is less than the sum of each separate measure potential. This is because of interactions between measures and competition between measures. Interactions result from installation of multiple measures in the same facility. For example, if one insulates a building, the heating load is reduced. As a result, if one then installs a high efficiency furnace, savings from the furnace will be lower because the overall heating needs of the building have been lowered. As a result, interactions between measures should be taken into account to avoid over-estimating savings potential. Because economic potential assumes all possible measures are adopted, interactions assume every building does all applicable measures. Interactions are accounted for by ranking each set of interacting measures by total savings, and assuming the greatest savings measure is installed first, and then the next highest savings measure. This is a conservative approach in that it is more likely that some measures with marginal savings may not pass the cost-effectiveness test after all interactions are accounted for.

Measures that compete also need to be adjusted for. These are two or more efficiency measures that can both be applied to the same application, but only one can be chosen. An example is choosing between replacing an incandescent lamp with either a CFL or an LED, but not both. In this case, the total penetration for all competing measures is 100%, with priority given to the measures based on ranking them from highest savings to lowest savings. If the first measure is applicable in all situations, it would have 100% penetration and all other competing measures would show no potential. If on the other hand, the first measure could only be installed in 50% of opportunities, then the second measure would capture the remaining opportunities.

To estimate the economic potential we generally assumed 100% installation of market-driven measures (natural replacement, new construction/renovation) constrained by measure cost-effectiveness and other limitations as appropriate, such as to account for mutually exclusive measures.

Implementation of retrofit measures was considered to be resource-constrained, i.e., it would not be possible to install all cost-effective retrofit measures all at once. The retrofit penetrations rates ramped up from 2% to 10% per year over the first 5 years, then continued at 10% per year through year 12. This effectively represented capturing all retrofit opportunities over the 12-year study period. With these assumptions the economic potential essentially captures all available cost-effective efficiency potential for retrofit measures by the end of the study period.

For measures that are market-driven only (new construction, renovation, and/or natural replacement) and which have measure lives longer than 12 years, the turnover rate is such that not all of the economic potential will be captured over the 12-year study period. For example, a high-efficiency boiler measure with a 20-year measure life may not be cost-effective for early-retirement retrofit, but passes for natural replacement. If so, only about 5% (1/20th) of the market turns over every year, so the entire market would not be replaced within the 12-year study period. For this measure the 12-year economic potential would be less than the 20-year economic potential.

APPENDICES

APPENDIX A: ENERGY SALES FORECAST

See the Energy Forecasts section of the report (page 30) for a description of the derivations of these energy sales forecasts and the data sources used.

Electric Forecast by Sector and Year (GWh)

Sector	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Residential	4,510	4,586	4,661	4,729	4,798	4,869	4,942	5,016	5,090	5,172	5,256	5,338
Commercial	4,835	4,877	4,917	4,954	4,991	5,029	5,068	5,108	5,148	5,190	5,233	5,276
Industrial	2,735	2,754	2,768	2,776	2,787	2,801	2,809	2,815	2,822	2,820	2,814	2,810
Total	12,080	12,218	12,346	12,458	12,576	12,698	12,818	12,938	13,060	13,182	13,303	13,424

Natural Gas Forecast by Sector and Year (BBtu)

Sector	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Residential	10,557	10,711	10,869	11,028	11,188	11,348	11,508	11,668	11,828	11,988	12,149	12,309
Commercial	9,638	9,838	10,038	10,244	10,458	10,674	10,891	11,109	11,329	11,551	11,774	11,998
Industrial	19,837	19,606	19,387	19,181	18,987	18,804	18,631	18,468	18,314	18,169	18,032	17,903
Total	40,032	40,155	40,295	40,454	40,634	40,826	41,030	41,245	41,472	41,708	41,955	42,210

Table 15. Petroleum Fuels Forecast by Sector and Year (BBtu)

Sector	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Residential	6,208	6,270	6,270	6,270	6,270	6,270	6,270	6,270	6,270	6,270	6,270	6,270
Commercial	2,174	2,195	2,195	2,195	2,195	2,195	2,195	2,195	2,195	2,195	2,195	2,195
Industrial	2,449	2,473	2,473	2,473	2,473	2,473	2,473	2,473	2,473	2,473	2,473	2,473
Total	10,830	10,938	10,938	10,938	10,938	10,938	10,938	10,938	10,938	10,938	10,938	10,938

APPENDIX B: ENERGY SALES DISAGGREGATION

Commercial Electric Sales, 2014 (MWh)

EXISTING BUILDINGS

End-Use	Office	Retail	Grocery	Warehouse	Education	Health	Lodging	Restaurant	Data Center	Streetlighting	Other Com	Total
Indoor Lighting	404,251	147,752	72,816	119,230	124,755	84,768	42,412	68,232	2,325	-	323,510	1,390,050
Outdoor Lighting	14,357	7,038	2,781	-	4,073	3,300	2,094	2,527	-	39,969	16,793	92,933
Cooling	237,119	98,330	40,621	9,142	87,352	133,232	36,949	56,133	65,268	-	201,452	965,599
Ventilation	111,263	51,422	12,439	29,008	96,172	34,950	21,346	23,251	23,815	-	119,924	523,590
Water Heating	7,313	16,132	1,417	3,235	29,048	1,681	-	3,432	-	-	8,554	70,811
Refrigeration	42,892	26,282	198,032	31,626	28,395	11,502	10,427	83,035	-	-	75,252	507,443
Space Heating	20,072	6,324	1,776	7,273	17,003	6,788	2,055	5,380	-	-	26,311	92,982
Plug Loads	187,481	10,604	6,286	6,380	24,550	19,889	5,259	5,076	-	-	50,604	316,128
Food Service/Prep	-	-	4,207	-	12,323	6,656	7,391	88,331	-	-	25,401	144,309
Miscellaneous	7,113	20,922	9,646	18,882	80,729	35,971	8,300	10,015	-	-	74,880	266,459
Data Center	-	-	-	-	-	-	-	-	151,781	-	-	151,781
Total	1,031,861	384,805	350,020	224,778	504,401	338,736	136,235	345,413	243,190	39,969	922,679	**4,522,086**

NEW CONSTRUCTION and RENOVATION

End-Use	Office	Retail	Grocery	Warehouse	Education	Health	Lodging	Restaurant	Data Center	Streetlighting	Other Com	Total
Indoor Lighting	26,058	9,524	4,694	7,686	8,042	5,464	2,734	4,398	150	-	20,853	89,602
Outdoor Lighting	923	452	179	-	262	212	135	162	-	2,569	1,079	5,974
Cooling	15,267	6,331	2,615	589	5,624	8,578	2,379	3,614	4,202	-	12,971	62,171
Ventilation	7,164	3,311	801	1,868	6,193	2,250	1,375	1,497	1,534	-	7,722	33,715
Water Heating	473	1,043	92	209	1,878	109	-	222	-	-	553	4,578
Refrigeration	2,765	1,694	12,767	2,039	1,831	742	672	5,353	-	-	4,851	32,715
Space Heating	1,297	409	115	470	1,099	439	133	348	-	-	1,701	6,010
Plug Loads	12,096	684	406	412	1,584	1,283	339	328	-	-	3,265	20,397
Food Service/Prep	-	-	271	-	794	429	476	5,689	-	-	1,636	9,295
Miscellaneous	460	1,353	624	1,221	5,220	2,326	537	648	-	-	4,842	17,230
Data Center	-	-	-	-	-	-	-	-	9,756	-	-	9,756
Total	66,504	24,802	22,563	14,493	32,526	21,832	8,779	22,260	15,642	2,569	59,474	**291,443**

Commercial Gas Sales, 2014 (MMBtu)

EXISTING BUILDINGS

End-Use	Office	Retail	Grocery	Warehouse	Education	Health	Lodging	Restaurant	Multifamily Com	Other Com	**Total**
Space Heating	1,795,806	1,466,592	169,401	210,180	438,764	542,688	97,935	186,227	1,015,168	119,853	6,042,614
Water Heating	107,756	157,352	13,321	8,041	83,259	313,481	201,441	205,024	431,800	6,107	1,527,583
Food Service/Prep	24,801	198,235	53,145	-	11,221	42,250	22,683	332,283	9,853	2,030	696,502
Miscellaneous	182,497	261,615	-	-	40,927	93,269	-	-	51,286	9,419	639,014
Total	2,110,861	2,083,793	235,867	218,220	574,171	991,688	322,060	723,534	1,508,108	137,410	**8,905,713**
											-

NEW CONSTRUCTION and RENOVATION

End-Use	Office	Retail	Grocery	Warehouse	Education	Health	Lodging	Restaurant	Multifamily Com	Other Com	**Total**
Space Heating	115,900	94,652	10,933	13,565	28,317	35,025	6,321	12,019	65,518	7,735	389,985
Water Heating	6,952	10,151	859	519	5,371	20,223	12,995	13,226	27,856	394	98,547
Food Service/Prep	1,599	12,784	3,427	-	724	2,725	1,463	21,429	635	131	44,917
Miscellaneous	11,851	16,988	-	-	2,658	6,056	-	-	3,330	612	41,495
Total	136,301	134,576	15,220	14,084	37,070	64,029	20,779	46,674	97,340	8,872	**574,943**

Commercial Petroleum Fuel Sales, 2014 (MMBtu)

EXISTING BUILDINGS

End-Use	Office	Retail	Grocery	Warehouse	Education	Health	Lodging	Restaurant	Multifamily Com	Other Com	**Total**
Space Heating	452,841	452,350	50,989	47,828	125,084	133,801	68,355	152,253	253,438	30,046	1,766,984
Water Heating	-	10,942	1,233	1,157	5,715	45,851	-	3,683	87,575	727	156,883
Food Service/Prep	-	-	-	-	-	-	-	-	-	-	-
Miscellaneous	31,756	11,196	1,262	1,184	-	46,915	2,876	3,768	2,242	744	101,943
Total	484,597	474,488	53,484	50,169	130,799	226,566	71,231	159,704	343,256	31,516	**2,025,810**

NEW CONSTRUCTION and RENOVATION

End-Use	Office	Retail	Grocery	Warehouse	Education	Health	Lodging	Restaurant	Multifamily Com	Other Com	**Total**
Space Heating	29,121	29,089	3,279	3,076	8,044	8,604	4,396	9,791	16,298	1,932	113,629
Water Heating	-	705	79	75	368	2,955	-	237	5,645	47	10,112
Food Service/Prep	-	-	-	-	-	-	-	-	-	-	-
Miscellaneous	2,041	720	81	76	-	3,016	185	242	144	48	6,553
Total	31,162	30,514	3,440	3,226	8,412	14,575	4,581	10,270	22,087	2,027	**130,293**

Residential Electric Sales, 2014 (MWh)

EXISTING BUILDINGS

End-Use	Single Family	Multifamily Res	**Total**
Indoor Lighting	378,928	47,329	426,257
Cooling	387,005	48,338	435,344
Ventilation	102,647	12,821	115,468
Water Heating	535,282	66,859	602,141
Refrigeration	437,044	54,588	491,632
Space Heating	587,092	73,330	660,422
Plug Loads	346,956	43,336	390,292
Food Service/Prep	84,865	10,600	95,465
Kitchen/Laundry	255,725	31,941	287,667
Miscellaneous	710,263	88,714	798,977
Total	3,825,808	477,857	**4,303,665**

NEW CONSTRUCTION and RENOVATION

End-Use	Single Family	Multifamily Res	**Total**
Indoor Lighting	20,641	2,578	23,219
Cooling	21,056	2,630	23,686
Ventilation	5,585	698	6,283
Water Heating	29,246	3,653	32,899
Refrigeration	23,810	2,974	26,784
Space Heating	32,066	4,005	36,071
Plug Loads	18,917	2,363	21,280
Food Service/Prep	4,619	577	5,196
Kitchen/Laundry	13,987	1,747	15,734
Miscellaneous	38,811	4,848	43,658
Total	208,738	26,072	**234,811**

Residential Gas Sales, 2014 (MMBtu)

EXISTING BUILDINGS

End-Use	Single Family	Multifamily Res	Total
Space Heating	5,705,426	495,852	6,201,278
Water Heating	2,490,682	216,462	2,707,145
Food Service/Prep	787,223	68,417	855,640
Miscellaneous	210,545	18,298	228,843
Total	9,193,876	799,030	**9,992,906**

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NEW CONSTRUCTION and RENOVATION

End-Use	Single Family	Multifamily Res	Total
Space Heating	312,853	27,190	340,042
Water Heating	136,517	11,865	148,381
Food Service/Prep	43,133	3,749	46,882
Miscellaneous	11,616	1,010	12,626
Total	504,119	43,812	**547,931**

Residential Petroleum Fuel Sales, 2014 (MMBtu)

EXISTING BUILDINGS

End-Use	Single Family	Multifamily Res	Total
Space Heating	4,626,571	-	4,626,571
Water Heating	446,371	-	446,371
Food Service/Prep	111,704	-	111,704
Miscellaneous	673,253	-	673,253
Total	5,857,899	-	**5,857,899**

NEW CONSTRUCTION and RENOVATION

End-Use	Single Family	Multifamily Res	Total
Space Heating	256,346	-	256,346
Water Heating	24,790	-	24,790
Food Service/Prep	6,193	-	6,193
Miscellaneous	37,286	-	37,286
Total	324,615	-	**324,615**

Industrial Electric Sales, 2014 (MWh)

EXISTING BUILDINGS

End-Use	Industrial	**Total**
Indoor Lighting	129,552	129,552
Outdoor Lighting	12,165	12,165
Cooling	228,781	228,781
Space Heating	28,047	28,047
Miscellaneous	104,942	104,942
Industrial Process	2,059,715	2,059,715
Total	2,563,201	**2,563,201**

NEW CONSTRUCTION and RENOVATION

End-Use	Industrial	**Total**
Indoor Lighting	8,447	8,447
Outdoor Lighting	791	791
Cooling	14,899	14,899
Space Heating	1,834	1,834
Miscellaneous	6,864	6,864
Industrial Process	132,003	132,003
Total	164,837	**164,837**

Industrial Gas Sales, 2014 (MMBtu)

EXISTING BUILDINGS

End-Use	Industrial	Total
Space Heating	2,733,527	2,733,527
Miscellaneous	6,643,813	6,643,813
Industrial Process	9,426,450	9,426,450
Total	18,803,791	**18,803,791**
		-

NEW CONSTRUCTION and RENOVATION

End-Use	Industrial	Total
Space Heating	174,007	174,007
Miscellaneous	425,524	425,524
Industrial Process	607,237	607,237
Total	1,206,768	**1,206,768**

Industrial Petroleum Fuel Sales, 2014 (MMBtu)

EXISTING BUILDINGS

End-Use	Industrial	Total
Space Heating	231,747	231,747
Miscellaneous	849,230	849,230
Industrial Process	1,260,061	1,260,061
Total	2,341,038	**2,341,038**

NEW CONSTRUCTION and RENOVATION

End-Use	Industrial	Total
Space Heating	14,903	14,903
Miscellaneous	54,586	54,586
Industrial Process	80,863	80,863
Total	150,352	**150,352**

APPENDIX C: AVERAGE RETAIL RATES

Average Retail Rates by Sector and Year (2013$)

	Electricity ($/kWh)			Natural Gas ($/MMBtu)			Petroleum Fuels ($/MMBtu)		
Year	Res	Com	Ind	Res	Com	Ind	Res	Com	Ind
2014	0.14	0.10	0.08	13.90	12.27	11.15	25.95	19.74	16.92
2015	0.14	0.10	0.08	13.64	12.01	11.24	25.49	19.34	16.64
2016	0.14	0.10	0.09	14.18	12.60	12.15	25.71	19.57	16.87
2017	0.14	0.10	0.09	14.48	12.87	12.47	26.40	20.25	17.31
2018	0.14	0.10	0.09	14.87	13.25	12.98	26.86	20.73	17.80
2019	0.14	0.10	0.09	15.07	13.44	13.20	27.33	21.21	18.15
2020	0.14	0.10	0.09	15.24	13.59	13.37	27.77	21.64	18.58
2021	0.14	0.10	0.09	15.43	13.77	13.57	28.14	22.04	18.94
2022	0.14	0.10	0.09	15.74	14.08	13.97	28.53	22.49	19.33
2023	0.14	0.10	0.09	16.04	14.37	14.36	28.91	22.85	19.69
2024	0.14	0.10	0.09	16.23	14.55	14.60	29.26	23.20	20.06
2025	0.14	0.10	0.09	16.39	14.68	14.75	29.62	23.56	20.38
2026	0.14	0.10	0.09	16.62	14.88	15.03	29.97	23.90	20.76
2027	0.14	0.10	0.09	16.73	14.96	15.12	30.29	24.22	21.13
2028	0.14	0.10	0.09	16.94	15.13	15.34	30.61	24.53	21.50
2029	0.14	0.10	0.09	17.13	15.28	15.53	30.92	24.83	21.81
2030	0.14	0.10	0.09	17.35	15.46	15.76	31.21	25.11	22.21
2031	0.14	0.10	0.09	17.61	15.68	16.08	31.50	25.39	22.33
2032	0.14	0.10	0.09	17.78	15.81	16.23	31.79	25.69	22.80
2033	0.14	0.10	0.09	18.00	16.00	16.49	32.12	26.03	23.17
2034	0.14	0.10	0.09	18.36	16.35	16.98	32.49	26.42	23.48
2035	0.14	0.10	0.09	18.76	16.75	17.54	32.91	26.85	24.05
2036	0.14	0.11	0.10	19.21	17.21	18.21	33.34	27.31	24.48
2037	0.14	0.11	0.10	19.64	17.66	18.84	33.80	27.78	24.98
2038	0.14	0.11	0.10	20.10	18.14	19.54	34.17	28.17	25.31
2039	0.15	0.11	0.10	20.29	18.29	19.73	34.60	28.61	25.88
2040	0.15	0.11	0.10	20.65	18.65	20.25	35.00	29.04	26.32
2041	0.15	0.11	0.10	20.65	18.65	20.25	35.00	29.04	26.32
2042	0.15	0.11	0.10	20.65	18.65	20.25	35.00	29.04	26.32
2043	0.15	0.11	0.10	20.65	18.65	20.25	35.00	29.04	26.32
2044	0.15	0.11	0.10	20.65	18.65	20.25	35.00	29.04	26.32
2045	0.15	0.11	0.10	20.65	18.65	20.25	35.00	29.04	26.32
2046	0.15	0.11	0.10	20.65	18.65	20.25	35.00	29.04	26.32
2047	0.15	0.11	0.10	20.65	18.65	20.25	35.00	29.04	26.32
2048	0.15	0.11	0.10	20.65	18.65	20.25	35.00	29.04	26.32
2049	0.15	0.11	0.10	20.65	18.65	20.25	35.00	29.04	26.32
2050	0.15	0.11	0.10	20.65	18.65	20.25	35.00	29.04	26.32

APPENDIX D: MEASURE CHARACTERIZATIONS

Abbreviations:

Applicable Markets:
- Ret = Retrofit
- NC = New Construction
- Reno = Renovation
- Repl = Natural Replacement

Sector:
- Com = Commercial
- Res = Residential
- Ind = Industrial

Other:
- NG = Natural Gas
- Petro = Petroleum Fuels
- CEE = Consortium for Energy Efficiency
- IECC = International Energy Conservation Code

Electric Measures

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Cooling	NC, Reno, Repl	High-eff AC CEE Tier I	Packaged or split system unitary air conditioner meeting CEE Tier I efficiency criteria (CEE Commercial Unitary AC & HP Specs, Jan 2012). High efficiency level reflects weighted average by size and type of units.	New unitary air conditioner meeting relevant energy codes or federal standards. Baseline efficiency reflects weighted average by size and type.	15.0	6%	$1.09	90	134,102, 93, 168	135
Com	Cooling	Ret	High-eff AC CEE Tier I	Packaged or split system unitary air conditioner meeting CEE Tier I efficiency criteria (CEE Commercial Unitary AC & HP Specs, Jan 2012). High efficiency level reflects weighted average by size and type of units.	Existing stock efficiency unitary air conditioner. Existing stock efficiency reflects weighted average by size and type.	15.0	19%	$2.91	90	134,92,93,102,168	3, 135

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Cooling	NC, Reno, Repl	High-eff AC CEE Tier II	Packaged or split system unitary air conditioner meeting CEE Tier II efficiency criteria (CEE Commercial Unitary AC & HP Specs, Jan 2012). High efficiency level reflects weighted average by size and type of units.	New unitary air conditioner meeting relevant energy codes or federal standards. Baseline efficiency reflects weighted average by size and type.	15.0	10%	$1.09	90	134,102, 93, 168	135
Com	Cooling	Ret	High-eff AC CEE Tier II	Packaged or split system unitary air conditioner meeting CEE Tier II efficiency criteria (CEE Commercial Unitary AC & HP Specs, Jan 2012). High efficiency level reflects weighted average by size and type of units.	Existing stock efficiency unitary air conditioner. Existing stock efficiency reflects weighted average by size and type.	15.0	23%	$2.55	90	134,92,93,168	3135
Com	Cooling	NC, Reno, Repl	High-eff HP CEE Tier I -Cool	Single or polyphase packaged or split system unitary heat pump meeting CEE Tier I efficiency criteria. High efficiency level will reflect weighted average by size and type of units.	New unitary heat pump meeting relevant energy codes or federal standards. Baseline efficiency reflects weighted average by size and type.	15.0	4%	$3.00	90	134,102, 93, 168	136, 135
Com	Cooling	Ret	High-eff HP CEE Tier I -Cool	Single or polyphase packaged or split system unitary heat pump meeting CEE Tier I efficiency criteria. High efficiency level will reflect weighted average by size and type of units.	Existing stock efficiency unitary heat pump. Existing stock efficiency will reflect weighted average by size and type.	15.0	14%	$5.35	90	134,92,93,168	136, 135
Com	Cooling	NC, Reno, Repl	High-eff HP CEE Tier II -Cool	Single or polyphase packaged or split system unitary heat pump meeting an efficiency criteria substantially above CEE Tier II. High efficiency level will reflect the maximum level available from multiple major manufacturers, weighted by size and type of units.	Standard efficiency new unitary heat pump. Baseline efficiency will reflect weighted average by size and type.	15.0	11%	$0.79	90	134,102, 93,168	136

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Cooling	Ret	High-eff HP CEE Tier II -Cool	Single or polyphase packaged or split system unitary heat pump meeting an efficiency criteria substantially above CEE Tier II. High efficiency level will reflect the maximum level available from multiple major manufacturers, weighted by size and type of units.	Existing stock efficiency unitary heat pump. Existing stock efficiency will reflect weighted average by size and type.	15.0	22%	$3.37	90	134,92,93,168	136
Com	Cooling	NC, Reno, Repl	Water src HP v. air src -Cool	Water cooled heat pump using a water loop as a heat sink.	Standard efficiency unitary heat pump.	15.0	29%	$0.49	1, 18, 22	93, 102, 103, 168	1, 170
Com	Cooling	NC, Reno, Repl	Ground source HP -Cool	Heat pump using ground as a heat sink. Either trench or well type.	Standard efficiency unitary heat pump.	20.0	49%	$1.71	1, 18, 22	93, 102, 103, 168	104
Com	Cooling	Reno, Repl	HE Room AC	A 'room air conditioner' is defined as a consumer product, other than a 'packaged terminal air conditioner,' which is powered by a single phase electric current and which is an encased assembly designed as a unit for mounting in a window or through the wall for the purpose of providing delivery of conditioned air to an enclosed space. It includes a prime source of refrigeration and may include a means for ventilating and heating. Upgrade to EER 10.8 (consistent with ENERGY STAR criteria for typical unit as of 5/27/09)	Standard efficiency Room AC unit meeting federal manufacturing standards.	9.0	9%	$0.39	90	15, 16, 93	17

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Cooling	Ret	HE Room AC	A 'room air conditioner' is defined as a consumer product, other than a ‘packaged terminal air conditioner,’ which is powered by a single phase electric current and which is an encased assembly designed as a unit for mounting in a window or through the wall for the purpose of providing delivery of conditioned air to an enclosed space. It includes a prime source of refrigeration and may include a means for ventilating and heating. Upgrade to EER 10.8 (consistent with ENERGY STAR criteria for typical unit as of 5/27/09)	Old window AC unit (7.5+ years old)	9.0	9%	$1.70	90	15, 16, 93	17
Com	Cooling	NC, Reno, Repl	High-efficiency chillers Tier I	High efficiency water cooled chillers (represents weighted average of different types and sizes) - Tier I	Standard efficiency water cooled chiller	25.0	20%	$1.54	1	102, 105, 93, 168	3, 39
Com	Cooling	Ret	High-efficiency chillers Tier I	High efficiency water cooled chillers (represents weighted average of different types and sizes) - Tier I	Standard efficiency water cooled chiller	25.0	29%	$2.62	1	92, 93, 105, 168	3, 39
Com	Cooling	NC, Reno, Repl	High-efficiency chillers Tier II	High efficiency water cooled chillers (represents weighted average of different types and sizes) - Tier II	Standard efficiency water cooled chiller	25.0	31%	$1.22	1	102, 105, 93, 168	3
Com	Cooling	Ret	High-efficiency chillers Tier II	High efficiency water cooled chillers (represents weighted average of different types and sizes) - Tier II	Standard efficiency water cooled chiller	25.0	38%	$2.15	1	92, 93, 105, 168	3
Com	Cooling	NC, Reno	Opt unitary HVAC dist/ctrl sys	High efficiency distribution system for unitary systems, based on mix of measures to optimize the total system efficiency. Potentially including controls, economizers, VFDs, VAV, better design, etc. This is mainly a design measure, applicable to NC and large renovation.	New construction standard efficiency unitary HVAC distribution system	15.0	30%	$0.53	40	51,93	3, 74, 39

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Cooling	NC, Reno	Opt chiller dist/ctrl sys	High efficiency distribution system for chiller systems, based on mix of measures to optimize the total system efficiency. Potentially including controls, economizers, VFDs, better design, etc.	New construction standard efficiency unitary HVAC distribution system	10.0	20%	$0.53	22	64, 39	3, 74, 39
Com	Cooling	NC, Reno	EMS/Controls - Cool	Energy management system and/or other controls to optimize control of HVAC system. Could include scheduling, optimal start-stop, chiller reset control, dual enthalpy economizers, CO2 sensors, etc.	No building automation	15.0	18%	$0.70	22	41, 42,114, 150	48, 75, 114
Com	Cooling	Ret	EMS/Controls - Cool	Energy management system and/or other controls to optimize control of HVAC system. Could include scheduling, optimal start-stop, chiller reset control, dual enthalpy economizers, CO2 sensors, etc.	No building automation	15.0	18%	$1.05	22	41, 42, 114, 150	48, 75, 114
Com	Cooling	NC, Reno, Repl	Dual enthalpy economizer	Dual enthalpy economizers with electronic controls to optimize use of outside air to reduce cooling loads.	Standard efficiency economizers, represents a mix of dry-bulb and single enthalpy.	9.8	7%	$1.37	1	168, 1	3
Com	Cooling	Ret	Dual enthalpy economizer	Dual enthalpy economizers with electronic controls to optimize use of outside air to reduce cooling loads.	Existing stock, represents a mix of dry-bulb and fixed dampers.	9.8	10%	$1.01	1	168, 1	3
Com	Cooling	NC, Reno, Repl	Demand controlled ventilation - Cool	Adjust ventilation rates based on indoor-air quality (typically by monitoring CO2 levels with sensors)	Ventilation system in which the outside air ventilation rate is fixed when the building is occupied	10.0	19%	$0.26	1	41, 25, 76, 150, 168	109
Com	Cooling	Ret	Demand controlled ventilation - Cool	Adjust ventilation rates based on indoor-air quality (typically by monitoring CO2 levels with sensors)	Ventilation system in which the outside air ventilation rate is fixed when the building is occupied	10.0	19%	$0.32	1	41, 25, 76, 150, 168	109
Com	Cooling	Ret	HVAC tune-up - Cool	Optimize an existing HVAC system by adjusting refrigerant charge, air flow, and control set-points for maximum efficiency.	HVAC system with unoptomized airflow and refrigerant charge	6.0	8%	$0.13	39	61, 150	78, 79

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Cooling	NC, Reno	Duct sealing - Cool	Seal HVAC ductwork with aerosol-based sealant to reduce air leakage outside the conditioned space and the consequent energy loss.	Leaky and unsealed ducts	25.0	12%	$0.16	25	93, 150	80, 119
Com	Cooling	Ret	Duct sealing - Cool	Seal HVAC ductwork with aerosol-based sealant to reduce air leakage outside the conditioned space and the consequent energy loss.	Leaky and unsealed ducts	25.0	12%	$0.16	25	93, 150	80, 119
Com	Cooling	NC, Reno, Repl	Low Flow Fume Hood	High efficiency low-flow fume hoods, typically used in laboratories, operate on the principle of an air supply with low turbulence intensity in the face of the hood. This alternative design results in significantly reduced volumes of exhaust air, which means less energy needed to move that air, while still providing sufficient air flow to dilute contaminants in the hood.	Constant volume (CV) and variable air volume (VAV) fume hoods with an average face velocity of >= 90 ft/min	25.0	44%	$0.38	88	88, 89	88, 89
Com	Cooling	NC, Reno, Repl	HE stove hood - Cool	Optimized stove hoods to minimize conditioned make-up air requirements.	Standard stove hoods	20.0	10%	$0.51	27	62, 63, 81	63, 81
Com	Cooling	Ret	HE stove hood - Cool	Optimized stove hoods to minimize conditioned make-up air requirements.	Standard stove hoods	20.0	10%	$0.51	27	62, 63, 81	63, 81
Com	Cooling	NC, Reno, Repl	HP window glazing Tier I - Cool	Currently available high efficiency glazing	The baseline condition is assumed to be single pane clear glass with a solar heat gain coefficient of 0.87	20.0	6%	$0.08	91	93	39
Com	Cooling	Ret	Window Film	Window films reduce solar heat gain in the summer by blocking infrared radiation passing through windows. This reduces the cooling load in the summer	single pane clear glass in commercial buildings with a solar heat gain coefficient of 0.87	10.0	5%	$0.68	0	93	91
Com	Cooling	NC, Reno, Repl, Ret	Hospitality control - cooling	System controlling HVAC and lighting for hotels/motels	Typical hotel room with no key card control or occupancy sensor	15.0	20%	$0.17	25	25	25

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Cooling	Ret	Cool roof	White roofing material or coating, to reflect the sun and reduce air-conditioning loads	Typical black roof	20.0	32%	$5.13	90	141	142
Com	Cooling	NC, Reno, Repl	Cool roof	White roofing material or coating, to reflect the sun and reduce air-conditioning loads	Typical black roof with typical reflectance and absorption	20.0	32%	$0.46	90	141	142
Com	Cooling	NC, Reno, Repl	Data centers virtualization - Cool	Data Center reduced cooling loads associated with electric savings for computer loads.	Typical data center without server virtualization	5.0	48%	$0.17	57	57, 62	86, 39
Com	Cooling	Ret	Data centers virtualization - Cool	Data Center reduced cooling loads associated with electric savings for computer loads.	Typical data center without server virtualization	5.0	48%	$0.17	57	57, 62	86, 39
Com	Data Center	NC, Reno, Repl	Data centers virtualization - IT	Data Center energy savings for information technology (computer loads) at facilities or rooms used to house computer servers and data systems through the use of server virtualization.	Typical data center without server virtualization	5.0	48%	$0.17	57	57, 62	86, 39
Com	Data Center	Ret	Data centers virtualization - IT	Data Center energy savings for information technology (computer loads) at facilities or rooms used to house computer servers and data systems through the use of server virtualization.	Typical data center without server virtualization	5.0	48%	$0.17	57	57, 62	86, 39
Com	Whole Building	NC, Reno	Commissioning -Elec	Whole building commissioning of new buildings to ensure optimized design, installation and operation of systems.	New Construction building with no commissioning performed	7.0	7%	$0.55	25, 54, 55, 56	115	115

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Whole Building	NC	Integrated bldg design Tier I - Elec	Reflects comprehensive, optimized design of new buildings addressing all end-uses and interactions between them on a systems basis. Measures include, but are not limited to, improved air barrier performance, minimum IAQ performance, lighting controls, improved lighting power density, improved mechanical equipment efficiency, and demand controlled ventilation.	New building conforming to ASHARE 90.1-2007	15.3	36%	$0.61	58	184	184
Com	Whole Building	NC	Building operational efficiency (behavioral)	Reflects an amalgamation of both post-consumption (indirect) and real-time (direct) energy usage feedback to building managers and occupants via monthly mailing, on-site displays, etc., as could be supported by Advanced Metering Infrastructure (AMI) - an emerging technology.	New building without planned direct / indirect feedback on electric usage	5.0	3%	$0.52	0	0	25, 39
Com	Whole Building	Ret	Building operational efficiency (behavioral)	Reflects an amalgamation of both post-consumption (indirect) and real-time (direct) energy usage feedback to building managers and occupants via monthly mailing, on-site displays, etc., as could be supported by Advanced Metering Infrastructure (AMI) - an emerging technology.	Building without direct / indirect feedback on electric usage	5.0	3%	$0.52	0	0	25, 39
Com	Whole Building	Ret	Behavioral Measures -Elec	Includes occupant training, interactive meters w/ real-time pricing capability.	No Behavioral Modification Program	1.0	3%	$0.09	185	185	39
Com	Food Preparation	Ret	HE kitchen equipment - elec, 2 meal	High-efficiency commercial electric kitchen cooking/warming equipment (holding cabinet, steamer, combination oven, deep fryer, griddle) for a restaurant that serves 2 meals or less per day	Standard Food Preparation Equipment	11.8	27%	$1.35	91, 97	97	97

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Food Preparation	NC, Reno, Repl	HE kitchen equipment - elec, 2 meal	High-efficiency commercial electric kitchen cooking/warming equipment (holding cabinet, steamer, combination oven, deep fryer, griddle) for a restaurant that serves 2 meals or less per day	Standard Food Preparation Equipment	11.8	27%	$0.12	91, 97	97	97
Com	Food Preparation	Ret	HE kitchen equipment - elec, 3 meal	High-efficiency commercial electric kitchen cooking/warming equipment (holding cabinet, steamer, combination oven, deep fryer, griddle) for a restaurant that serves 3 meals per day	Standard Food Preparation Equipment	11.9	26%	$1.41	91, 97	97	97
Com	Food Preparation	NC, Reno, Repl	HE kitchen equipment - elec, 3 meal	High-efficiency commercial electric kitchen cooking/warming equipment (holding cabinet, steamer, combination oven, deep fryer, griddle) for a restaurant that serves 3 meals per day	Standard Food Preparation Equipment	11.9	26%	$0.11	91, 97	97	97
Com	Space Heating	NC, Reno, Repl, Ret	Hospitality control - heating	System controlling HVAC and lighting for hotels/motels	Typical hotel room with no key card control or occupancy sensor	15.0	20%	$0.17	25	25	25
Com	Indoor Lighting	Ret	HPT8 lamp/ballast (T12 baseline)	Install High Performance T8 lamps and low-ballast factor electronic ballast in existing fixtures, replacing T12 lighting	EE T12 with EEMAG ballast	15.0	32%	$0.67	1	168, 168	1
Com	Indoor Lighting	Ret	HPT8 lamp/ballast (T8 baseline)	Install High Performance T8 lamps and low-ballast factor electronic ballast in existing fixtures, replacing standard T8 lighting	Standard T8s	15.0	16%	$1.67	1	168, 168	1
Com	Indoor Lighting	Repl	Reduce W T8 lamp/ballast (for HPT8)	When replacing a High Performance T8 and ballast, replace with a 25 or 28 Watt lamp and high performance ballast as opposed to a HP 32 watt lamp.	32 Watt High Performance T8s	15.0	13%	-	1	168, 87	68
Com	Indoor Lighting	Ret	Reduce W T8 lamp/ballast (for HPT8)	When replacing a High Performance T8 and ballast, replace with a 25 or 28 Watt lamp and high performance ballast as opposed to a HP 32 watt lamp.	32 Watt High Performance T8s	15.0	13%	$2.71	1	168, 87	68

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Indoor Lighting	Repl	Reduce W T8 lamp/ballast (for stnd T8)	When replacing a Standard T8, replace with a 25 or 28 watt T8 and CEE certified ballast as opposed to a standard lamp and ballast	32 Watt Standard T8 lamp and ballast	15.0	16%	$0.71	1	168, 168	68
Com	Indoor Lighting	Ret	Reduce W T8 lamp/ballast (for stnd T8)	When replacing a Standard T8, replace with a 25 or 28 watt T8 and CEE certified ballast as opposed to a standard lamp and ballast	32 Watt Standard T8 lamp and ballast	15.0	16%	$1.62	1	168, 168	68
Com	Indoor Lighting	Repl	Reduce W T8 relamp (for HPT8)	When replacing a High Performance T8, replace with a 25 or 28 Watt lamp as opposed to a HP 32 watt lamp.	32 Watt High Performance T8 lamp and ballast	5.1	11%	-	1	168, 87	68
Com	Indoor Lighting	Ret	Reduce W T8 relamp (for HPT8)	When replacing a High Performance T8, replace with a 25 or 28 Watt lamp as opposed to a HP 32 watt lamp.	32 Watt High Performance T8 lamp and ballast	5.1	11%	$2.42	1	168, 87	68
Com	Indoor Lighting	Repl	Reduce W T8 relamp (for stnd T8)	When replacing a Standard T8, replace with a 25 or 28 Watt lamp as opposed to a HP 32 watt lamp.	32 Watt High Performance T8 lamp	5.1	22%	$0.14	1	168, 168	68
Com	Indoor Lighting	Ret	Reduce W T8 relamp (for stnd T8)	When replacing a Standard T8, replace with a 25 or 28 Watt lamp as opposed to a HP 32 watt lamp.	32 Watt Standard T8	5.1	22%	$0.43	1	168, 168	68
Com	Indoor Lighting	Ret	HPT8 fixture (T12 baseline)	High Performance T8 fixture w/ Electronic Ballast and tandem wiring where appropriate, replacing T12	EE T12 with EE Mag ballast	15.0	32%	$1.07	1	168, 168	68
Com	Indoor Lighting	NC, Reno, Repl	HPT8 fixture (T8 baseline)	High Performance T8 fixture w/ Electronic Ballast and tandem wiring where appropriate, replacing standard T8	Standard T8s	15.0	16%	$0.76	1	168, 168	1
Com	Indoor Lighting	Ret	HPT8 fixture (T8 baseline)	High Performance T8 fixture w/ Electronic Ballast and tandem wiring where appropriate, replacing standard T8	Standard T8s	15.0	16%	$2.67	1	168, 168	68

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Indoor Lighting	NC, Reno, Repl	HE fixtures/design Tier I (2009 baseline)	High efficiency fixtures and design to reduce lighting power density. Generally reflects mid-level efficiency, typically including high efficiency fixtures and improved fixture layout, including use of indirect lighting. Does not include controls, which are covered elsewhere. Baseline of IECC 2009.	IECC 2009	15.0	21%	$0.37	168	168, 50	69
Com	Indoor Lighting	NC, Reno, Repl	HE fixtures/design Tier II	High efficiency fixtures and design to reduce lighting power density. Generally reflects state-of-the-art systems to achieve maximum reductions. This can include numerous things, potentially including direct/indirect, auto dimming, low glare, T5s, specular reflectors, task lighting, distribution technologies (eg, light pipes, fiber optics), etc. Does not include controls, which are covered elsewhere.	HE fixtures/design Tier I	15.0	33%	$0.75	168	168, 52	69
Com	Indoor Lighting	Ret	HE fixtures/design Tier II	High efficiency fixtures and design to reduce lighting power density. Generally reflects state-of-the-art systems to achieve maximum reductions. This can include numerous things, potentially including direct/indirect, auto dimming, low glare, T5s, specular reflectors, task lighting, distribution technologies (eg, light pipes, fiber optics), etc. Does not include controls, which are covered elsewhere.	HE fixtures/design Tier I	15.0	45%	$1.59	168	0	69

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Indoor Lighting	NC, Reno, Repl	HE fixtures/design Tier III	Emerging technologies (e.g., LEDs, Organic LEDs, daylighting) combined with emphasis on increased overall system efficiency.	HE fixtures/design Tier II	15.0	41%	$0.75	168	168, 39	69
Com	Indoor Lighting	Ret	HE fixtures/design Tier III	Emerging technologies (e.g., LEDs, Organic LEDs, daylighting) combined with emphasis on increased overall system efficiency.	HE fixtures/design Tier II	15.0	53%	$1.59	168	0	69
Com	Indoor Lighting	NC, Reno, Repl	CFL fixture - interior 2012-14	Permanently installed Compact Fluorescent Lamp fixture	Incandescent fixture meeting EISA 2007 lighting performance standards (e.g., efficient halogen lamp)	12.0	59%	$0.42	168	168, 1	168
Com	Indoor Lighting	Ret	CFL fixture - interior 2012-14	Permanently installed Compact Fluorescent Lamp fixture	Incandescent fixture meeting EISA 2007 lighting performance standards (e.g., efficient halogen lamp)	12.0	59%	$1.34	168	168, 1	70
Com	Indoor Lighting	NC, Reno, Repl	CFL spiral 2012-14	Compact Fluorescent Lamp spiral, for interior	High-efficiency halogen lamp	4.8	62%	$0.03	168	168, 53	71, 168
Com	Indoor Lighting	Ret	CFL spiral 2012-14	Compact Fluorescent Lamp spiral, for interior	High-efficiency halogen lamp	4.8	62%	$0.04	168	168, 53	71, 168
Com	Indoor Lighting	NC, Reno, Repl	LED track lighting	LED replacements for track lighting	Halogen Par 38	15.0	80%	$0.73	1, 157, 162	1, 156	1, 157
Com	Indoor Lighting	Ret	LED track lighting	LED replacements for track lighting	Halogen Par 38	15.0	80%	$1.04	1, 157, 162	1, 156	1, 157
Com	Indoor Lighting	NC, Reno, Repl	LED downlighting	LED replacements for recessed downlights. Recessed lights are used to concentrate light in a downward direction.	Weighted average of 65W BR30 & 50W PAR30 downlight lamps	15.0	68%	$0.48	1, 157, 162	1, 157	46, 157
Com	Indoor Lighting	Ret	LED downlighting	LED replacements for recessed downlights. Recessed lights are used to concentrate light in a downward direction.	Weighted average of 65W BR30 & 50W PAR30 downlight lamps	15.0	68%	$0.98	1, 157, 162	1, 157	46, 157

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Indoor Lighting	NC, Reno, Repl	LED Lamp, directional	LED screw and pin-based lamps that replace PAR bulbs in non-dedicated fixtures. These are common in retail and museum applications where directional highlighting is common	weighted average of CFL and Halogen PAR bulb	13.6	79%	$0.31	1, 62	1, 156	1, 157
Com	Indoor Lighting	Ret	LED Lamp, directional	LED screw and pin-based lamps that replace PAR bulbs in non-dedicated fixtures. These are common in retail and museum applications where directional highlighting is common	weighted average of CFL and Halogen PAR bulb	13.6	79%	$0.47	1, 62	1, 156	1, 157
Com	Indoor Lighting	NC, Reno, Repl	LED Lamp, standard and decorative	LED screw and pin-based lamps that fit into traditional incandescent and CFL sockets. Varieties include PAR, MR, decorative candelabra, and standard A-style lamps.	Weighted average of EC Halogens, and incandescents	8.5	67%	$0.48	1, 62	1, 157	46, 168
Com	Indoor Lighting	Ret	LED Lamp, standard and decorative	LED screw and pin-based lamps that fit into traditional incandescent and CFL sockets. Varieties include PAR, MR, decorative candelabra, and standard A-style lamps.	Weighted average of EC Halogens, and incandescents	8.5	67%	$0.65	1, 62	1, 157	46, 1, 168
Com	Indoor Lighting	NC, Reno, Repl	LED refrig case light fixtures	LED refrigerated case light fixtures are installed in walk-in refrigerated coolers and freezers where they excel due to the cold temperature. They replace linear fluorescent fixtures that perform poorly in cold temperatures.	T8 linear fluorescent	8.1	55%	$0.46	168	168	168
Com	Indoor Lighting	Ret	LED refrig case light fixtures	LED refrigerated case light fixtures are installed in walk-in refrigerated coolers and freezers where they excel due to the cold temperature. They replace linear fluorescent fixtures that perform poorly in cold temperatures.	T8 linear fluorescent	8.1	55%	$0.90	168	168	168

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Indoor Lighting	NC, Reno, Repl	LED Recessed Fixture	LED Recessed Fixtures replace linear fluorescent fixtures	average of T8 and HPT8 4' fixtures	19.5	37%	$1.70	1, 62, 158	1, 158	46, 1, 168
Com	Indoor Lighting	Ret	LED Recessed Fixture	LED Recessed Fixtures replace linear fluorescent fixtures	average of T8 and HPT8 4' fixtures	19.5	37%	$3.03	1, 62, 158	1, 158	46, 1, 168
Com	Indoor Lighting	NC, Reno, Repl	LED task lighting	LED task lighting is used to increase light levels in work spaces above ambient levels. Replaces Halogen and Fluorescent technology	Average of 50W Hal, 13W CFL and Linear T5	19.5	80%	$0.40	126, 162	124, 155	1, 124, 155
Com	Indoor Lighting	Ret	LED task lighting	LED task lighting is used to increase light levels in work spaces above ambient levels. Replaces Halogen and Fluorescent technology	Average of 50W Hal, 13W CFL and Linear T5	19.5	80%	$0.61	126, 162	124, 155	1, 124, 155
Com	Indoor Lighting	NC, Reno, Repl	Fluor high-low bay fixture - interior	Fluorescent fixture for high and low bay applications (assumes 4-lamp fixture). Generally for industrial warehouse and similar applications. Low bay is 10-15 ft.	average of 200W and 320W PSMH	15.0	47%	$0.15	168	1, 168	1, 60
Com	Indoor Lighting	Ret	Fluor high-low bay fixture - interior	Fluorescent fixture for high and low bay applications (assumes 4-lamp fixture). Generally for industrial warehouse and similar applications. Low bay is 10-15 ft.	average of 200W and 320W PSMH	15.0	47%	$0.49	168	1, 168	1, 60, 68
Com	Indoor Lighting	NC, Reno, Repl	LED High-Low Bay	LED fixture for high and low bay applications. Generally for industrial warehouse applications. Low bay is 10-15 ft.	MH 250 W CWA Pulse Start	15.0	55%	$0.58	1, 158, 168	1, 158, 168	1
Com	Indoor Lighting	Ret	LED High-Low Bay	LED fixture for high and low bay applications. Generally for industrial warehouse applications. Low bay is 10-15 ft.	MH 250 W CWA Pulse Start	15.0	55%	$1.20	1, 158, 168	1, 158, 168	1
Com	Indoor Lighting	NC, Reno, Repl	Occupancy on/off lighting control	On/off lighting control based on space occupancy	Manual control	10.0	30%	$0.21	168	168	48, 60, 168

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Indoor Lighting	Ret	Occupancy on/off lighting control	On/off lighting control based on space occupancy	Manual control	10.0	30%	$0.43	168	168	48, 60, 168
Com	Indoor Lighting	NC, Reno, Repl	Occupancy hi/low lighting control	Multilevel lighting control based on space occupancy. For example, to reduce lighting in the aisles of a warehouse.	Manual control	10.0	30%	$0.59	168	168, 1	72
Com	Indoor Lighting	Ret	Occupancy hi/low lighting control	Multilevel lighting control based on space occupancy. For example, to reduce lighting in the aisles of a warehouse.	Manual control	10.0	30%	$1.00	168	168, 1	72
Com	Indoor Lighting	NC, Reno, Repl	Daylight dimming	Automatic dimming in response to daylight, lumen depreciation and task needs to maintain light levels. For NC, optimization of natural light through shell measures is included under integrated building design.	Manual control	8.0	30%	$0.27	168	168	1, 168
Com	Indoor Lighting	Ret	Daylight dimming	Automatic dimming in response to daylight, lumen depreciation and task needs to maintain light levels. For NC, optimization of natural light through shell measures is included under integrated building design.	Manual control	8.0	30%	$0.38	168	168	1, 168
Com	Indoor Lighting	Ret	Wireless on-off lighting controls	On/off lighting controls attached to occupancy sensors. Eliminates the need for expensive cabling attached to each controlled light.	Manual control	10.0	30%	$0.47	0	0	183
Com	Indoor Lighting	Ret	LED exit sign	Light emitting diode exit sign	Fluorescent exit sign	7.0	94%	$0.26	1, 20	168	168
Com	Indoor Lighting	NC, Reno, Repl, Ret	Hospitality control - lighting	System controlling HVAC and lighting for hotels/motels	Typical hotel room with no key card control or occupancy sensor	15.0	33%	$0.17	25	25	25

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Miscellaneous	Ret	ECM Circulator Pump	Install a variable speed circulation pump instead of a constant speed pump	Circulator pump using a low efficiency shaded pole motor installed on the primary loop of a multiloop system, which runs constantly during the cooling season	20.0	65%	$0.65	1	1	1
Com	Office Equipment	MD	HE plug loads	Plug Load equipment, including computers, display, copier, fax, printer, power supply, TVs, and set top boxes	Standard Office equipment	4.0	66%	$0.07	168	131	131133
Com	Office Equipment	Ret	Office equipment control	Low cost measures that can be done as a retrofit to an office building. Includes Power Management, advanced plug strips/timers, monitor brightness settings, and occupant behavior.	Standard Office equipment control and standard power strips	3.2	29%	$0.11	131, 132	131	131
Com	Office Equipment	Ret	Hotel guestroom plug load reduction	efficient TVs and refrigerators in hotel guest rooms	Standard efficiency TVs and refrigerators	12.0	12%	$0.53	146	147	147
Com	Office Equipment	Ret, Repl	Smart strip plug outlets	A multi-plug power strip with the ability to automatically disconnect specific loads that are plugged into it depending on the power draw of a control load, also plugged into the strip.	Conventional power strip with no mechanism for disconnecting loads	8.0	3%	$0.66	0	118	118
Com	Outdoor Lighting	NC, Reno, Repl	LED minor exterior area lighting	LED general area lighting on the outside of commercial buildings. This includes walkway, security, signage, and façade lighting	175W MH	13.7	72%	$0.71	162	127	127
Com	Outdoor Lighting	Ret	LED minor exterior area lighting	LED general area lighting on the outside of commercial buildings. This includes walkway, security, signage, and façade lighting	CFLs, Halogen, and linear t5	13.7	72%	$1.03	162	127	127
Com	Outdoor Lighting	NC, Reno, Repl	CFL - exterior 2012-2014	Spiral CFL for exterior applications to replace incandescent, 2012-14	Halogen PAR38 spot lamp	3.5	62%	$0.04	1	1, 59	59

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Outdoor Lighting	Ret	CFL - exterior 2012-2014	Spiral CFL for exterior applications to replace incandescent, 2012-14	Halogen PAR38 spot lamp	3.5	62%	$0.08	1	1, 59	59
Com	Outdoor Lighting	NC, Reno	LED Parking/Roadway Fixtures	LED outdoor lighting for parking areas and general area lighting (not utility-owned). This includes cobra heads, other more decorative street lights and canopy lighting.	Weighted average of 400W MH, 250W MH and 250W HPS, lamps and housing/fixtures	11.4	72%	$0.49	162	46, 162	1
Com	Outdoor Lighting	Ret	LED Parking/Roadway Fixtures	LED outdoor lighting for parking areas and general area lighting (not utility-owned). This includes cobra heads, other more decorative street lights and canopy lighting.	Weighted average of 400W MH, 250W MH and 250W HPS lamps	11.4	72%	$0.60	162	46, 162	1
Com	Outdoor Lighting	NC, Reno, Repl	Exterior Occupancy Sensors	Occupancy sensors controlling outdoor lighting	no occ sensor	10.0	41%	$0.74	1	1	1
Com	Outdoor Lighting	Ret	Exterior Occupancy Sensors	Occupancy sensors controlling outdoor lighting	no occ sensor	10.0	41%	$1.22	1	1	1
Com	Outdoor Lighting	NC, Reno, Repl	LED Municipal Streetlighting	LED street lighting owned by utilities	Combination of 250W MH and 250W HPS cobra heads	11.4	41%	$0.76	19	169	169
Com	Outdoor Lighting	Ret	LED Municipal Streetlighting	LED street lighting owned by utilities	Combination of 250W MH and 250W HPS cobra heads	11.4	41%	$1.15	19	169	169
Com	Outdoor Lighting	NC, Reno	Improved ext lighting design	Reduced light levels and better outdoor lighting design. Includes reduced wattage lamps, better spacing, and use of cut-offs and reflectors to better control light and minimize glare	Standard exterior lighting practice	15.0	42%	$1.59	1	1, 30	30

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Outdoor Lighting	NC, Reno, Repl	Outdoor Lighting Timeclocks	Time controls save energy by reducing lighting time of use through preprogrammed scheduling. Generally they dim the fixture during periods of low activity, such as 12am-5am. Time controls are applicable to utility owned street lights as well as non-utility owned outdoor light fixtures such as those in parking garages and security lighting	Standard efficiency exterior area lighting using metal halide and high-pressure sodium technologies	15.0	50%	$0.36	1	0	154
Com	Outdoor Lighting	Ret	Outdoor Lighting Timeclocks	Time controls save energy by reducing lighting time of use through preprogrammed scheduling. Generally they dim the fixture during periods of low activity, such as 12am-5am. Time controls are applicable to utility owned street lights as well as non-utility owned outdoor light fixtures such as those in parking garages and security lighting	Standard efficiency exterior area lighting using metal halide and high-pressure sodium technologies	15.0	50%	$0.72	1	0	154
Com	Refrigeration	NC, Reno, Repl	Energy Star vending machine	High-efficiency refrigerated vending machines. Includes better lighting, controls and refrigeration.	Standard efficiency new vending machine purchases.	14.0	42%	-	34, 35, 26, 94	94	47
Com	Refrigeration	Ret	Vending miser	Vending miser or equivalent control to reduce lighting and refrigeration energy during low use periods	No control	10.0	38%	$0.28	1	93	85
Com	Refrigeration	NC, Reno, Repl	High-eff built-up refrigeration	High-efficiency built-up refrigeration systems for grocery and refrigerated warehouses. This potentially includes HE compressors, better design and controls, HE motors and VFDs.	Standard efficiency built-up refrigeration systems	10.0	25%	$0.48	18, 34	34, 62	34

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Refrigeration	Ret	High-eff built-up refrigeration	High-efficiency built-up refrigeration systems for grocery and refrigerated warehouses. This potentially includes HE compressors, better design and controls, HE motors and VFDs.	Existing stock efficiency built-up refrigeration systems	10.0	31%	$2.59	18, 34	34, 62	34
Com	Refrigeration	NC, Reno, Repl	High-eff reach-in refrig, freezers	High-efficiency stand-alone reach-in refrigeration & freezer units for grocery, convenience stores, restaurants and cafeterias. Efficiency improvements include better door heater control, better lighting, HE compressors, greater insulation.	Standard efficiency new reach-in refrigeration units.	9.0	26%	$0.39	20, 34, 35	93	97
Com	Refrigeration	NC, Reno, Repl	HE Ice Makers	High efficiency new ice machines	Standard efficiency new ice machines	8.0	9%	$0.09	98, 97	97	97
Com	Refrigeration	NC, Reno, Repl	High-efficiency small walk-in	High-efficiency small walk-in cooler with self-contained refrigeration system	Standard efficiency walk-in refrigeration system	13.0	54%	$0.10	1	34, 62	34
Com	Refrigeration	Ret	Walk-in refrig retrofit package	High efficiency walk-in refrigeration system retrofit improvements (includes economizer, humidistat, evaporator fan control, etc.)	Standard efficiency existing stock walk-in refrigeration systems	16.0	17%	$0.23	34, 38	49	49
Com	Refrigeration	NC, Reno, Repl	High-efficiency display coolers	High-efficiency refrigerated display coolers	Standard efficiency one door beverage merchandiser	8.5	35%	$0.26	34	62	34
Com	Refrigeration	Ret	High-efficiency display coolers	High-efficiency refrigerated display coolers	Standard efficiency existing stock display cooler	8.5	35%	$4.01	34	62	34
Com	Refrigeration	NC, Reno, Repl	Heat pump H2O heat from refrig -Refrig	Heat pump water heating using waste heat recovery from refrigeration systems (refrigeration component)	Air cooled refrigeration, traditional gas or electric water heating (note some electric water heating savings result as well)	14.0	5%	-	20	62	20

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Refrigeration	Ret	Heat pump H2O heat from refrig -Refrig	Heat pump water heating using waste heat recovery from refrigeration systems (refrigeration component)	Air cooled refrigeration, traditional gas or electric water heating (note some electric water heating savings result as well)	14.0	5%	-	20	62	20
Com	Space Heating	NC, Reno, Repl	High-eff HP CEE Tier I -Heat	See corresponding "Cool" measure.	New unitary heat pump meeting relevant energy codes or federal standards. Baseline efficiency reflects weighted average by size and type.	15.0	2%	$3.00	90	134,102, 93,168	136, 135
Com	Space Heating	Ret	High-eff HP CEE Tier I -Heat	See corresponding "Cool" measure.	Existing stock efficiency unitary heat pump. Existing stock efficiency will reflect weighted average by size and type.	15.0	7%	$5.35	90	134,92,93,168	136, 135
Com	Space Heating	NC, Reno, Repl	High-eff HP CEE Tier II -Heat	See corresponding "Cool" measure.	Standard efficiency new unitary heat pump. Baseline efficiency will reflect weighted average by size and type.	15.0	11%	$0.79	90	134,102, 93,168	136
Com	Space Heating	Ret	High-eff HP CEE Tier II -Heat	See corresponding "Cool" measure.	Existing stock efficiency unitary heat pump. Existing stock efficiency will reflect weighted average by size and type.	15.0	14%	$3.37	90	134,92,93,168	136
Com	Space Heating	NC, Reno, Repl	Water src HP v. air src -Heat	Water cooled heat pump using a water loop as a heat sink.	Standard efficiency unitary heat pump.	15.0	40%	$0.49	1, 18, 22	93, 102, 103, 168	104
Com	Space Heating	NC, Reno, Repl	Ground source HP -Heat	Heat pump using ground as a heat sink. Either trench or well type.	Standard efficiency unitary heat pump.	20.0	33%	$1.71	1, 18, 22	93, 102, 103, 168	104
Com	Space Heating	NC, Reno, Repl	HP window glazing Tier I - Elec Heat	Currently available high efficiency glazing	The baseline condition is assumed to be single pane clear glass with a solar heat gain coefficient of 0.87	20.0	24%	$0.08	91	93	39
Com	Ventilation	NC, Reno	EMS/Controls - Vent	See corresponding "Cool" measure.	No building automation	15.0	18%	$0.70	22	41, 42, 114, 150	48, 75, 114

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Ventilation	Ret	EMS/Controls - Vent	See corresponding "Cool" measure.	No building automation	15.0	18%	$1.05	22	41, 42, 114, 150	48, 75, 114
Com	Ventilation	NC, Reno, Repl	Demand controlled ventilation - Vent	See corresponding "Cool" measure.	Ventilation system in which the outside air ventilation rate is fixed when the building is occupied	10.0	10%	$0.26	1	25, 150	76
Com	Ventilation	Ret	Demand controlled ventilation - Vent	See corresponding "Cool" measure.	Ventilation system in which the outside air ventilation rate is fixed when the building is occupied	10.0	10%	$0.32	1	25, 150	77
Com	Ventilation	NC, Reno	Duct sealing - Vent	See corresponding "Cool" measure.	Leaky and unsealed ducts	25.0	9%	$0.16	25	93, 80, 150	80, 119
Com	Ventilation	Ret	Duct sealing - Vent	See corresponding "Cool" measure.	Leaky and unsealed ducts	25.0	9%	$0.16	25	93, 80, 150	80, 119
Com	Ventilation	NC, Reno, Repl	Variable Frequency Drive (VFD)	Variable frequency drive on applicable fans and pumps	No control or manual control with Inlet/outlet dampers or throttle valves	15.0	40%	$0.14	1, 18	1, 65	1, 48, 82
Com	Ventilation	Ret	Variable Frequency Drive (VFD)	Variable frequency drive on applicable fans and pumps	No control or manual control with Inlet/outlet dampers or throttle valves	15.0	40%	$0.13	1, 18	65, 93	1, 48, 82
Com	Ventilation	NC, Reno, Repl	HE stove hood - Vent	See corresponding "Cool" measure.	Standard stove hoods	20.0	68%	$0.51	27	62, 63, 81	63, 81
Com	Ventilation	Ret	HE stove hood - Vent	See corresponding "Cool" measure.	Standard stove hoods	20.0	68%	$0.51	27	62, 63, 81	63, 81
Com	Water Heating	Ret	Electric DHW pipe insulation	Electric Domestic Hot Water pipe insulation	Uninsulated hot water pipe	15.0	0%	$0.01	31, 32	93	127
Com	Water Heating	Ret	Electric water heater tank insulation	Electric water heater tank wrap insulation	Hot water tank without a tank wrap	10.0	1%	$0.09	91	93	127
Com	Water Heating	NC, Reno, Ret	Elec instant water heat vs. elec DHW	Electric point-of-use water heating with no storage capacity, as compared to electric DHW storage.	Standard centrally located electric storage water heater	10.0	34%	$0.01	30	45, 62	172

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Water Heating	Ret	Elec instant water heat vs. elec DHW	Electric point-of-use water heating with no storage capacity, as compared to electric DHW storage.	Standard centrally located electric storage water heater	10.0	34%	$0.13	30	45	172
Com	Water Heating	Ret	Low-flow pre-rinse spray valve, elec DHW	Low-flow pre-rinse spray valve for food service applications	Pre-rinse spray valve greater than 1.6gpm	5.0	47%	$0.03	168	168	39
Com	Water Heating	NC, Reno, Repl	HE clothes washer, elec DHW	High-efficiency commercial coin-op washers	Standard efficiency washer, elec DHW, electric dryer	11.0	28%	$0.47	33	168, 33, 62, 94	168, 33
Com	Water Heating	Ret	HE clothes washer, elec DHW	High-efficiency commercial coin-op washers	Standard efficiency washer, elec DHW, electric dryer	11.0	20%	$3.18	33	168, 33, 62, 94	33
Com	Water Heating	NC, Reno, Repl	Heat pump H2O heat from refrig -WH	Heat pump water heating using waste heat recovery from refrigeration systems (water heating component)	Air cooled refrigeration, traditional gas or electric water heating (note some electric water heating savings result as well)	14.0	43%	$0.35	20	64, 20	20
Com	Water Heating	Ret	Heat pump H2O heat from refrig -WH	Heat pump water heating using waste heat recovery from refrigeration systems (water heating component)	Air cooled refrigeration, traditional gas or electric water heating (note some electric water heating savings result as well)	14.0	50%	$0.38	20	64, 20	20
Com	Water Heating	Ret	Low-flow showerhead, elec DHW	0	0	10.0	0%	$0.01	91	91, 1, 116	91, 116
Com/ Ind	Elec Total	Reno	Deep Energy Retrofit - Electric	Deep energy retrofit going after deep savings in every building systems, mostly for the renovation market	Energy use of the existing building, before the deep energy retrofit occurs. Assumes energy use of typical existing building.	20.0	43%	$0.37	143	137	137

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com/ Ind	Elec Total	Ret	Retrocommissioning -Elec	Optimizing energy usage of existing buildings and systems using O&M, control calibration, etc.	A typical existing building that hasn't been commissioned	7.0	9%	$0.09	25, 54, 55, 56	115, 25	115
Ind	Cooling	NC, Reno, Repl	Industrial space cooling	Represents a comprehensive suite of industrial energy efficiency measures addressing space cooling	Standard efficiency for aggregated measures	10.0	6%	$0.75	181, 182	181, 182, 39	181, 182, 39
Ind	Cooling	Ret	Industrial space cooling	Represents a comprehensive suite of industrial energy efficiency measures addressing space cooling	Standard efficiency for aggregated measures	10.0	6%	$0.75	181, 182	181, 182, 39	181, 182, 39
Ind	Indoor Lighting	NC, Reno, Repl	Industrial lighting	Represents a comprehensive suite of industrial energy efficiency measures addressing indoor lighting.	Standard efficiency for aggregated measures	11.5	25%	$0.15	181, 182	181, 182, 39	181, 182, 39
Ind	Indoor Lighting	Ret	Industrial lighting	Represents a comprehensive suite of industrial energy efficiency measures addressing indoor lighting.	Standard efficiency for aggregated measures	11.5	34%	$0.15	181, 182	181, 182, 39	181, 182, 39
Ind	Industrial Process	NC, Repl	Industrial process	Represents a comprehensive suite of industrial energy efficiency measures addressing electric process energy.	Standard efficiency for aggregated measures	13.9	21%	$0.09	181, 182	181, 182, 39	181, 182, 39
Ind	Industrial Process	Ret	Industrial process	Represents a comprehensive suite of industrial energy efficiency measures addressing electric process energy.	Standard efficiency for aggregated measures	13.9	21%	$0.09	181, 182	181, 182, 39	181, 182, 39
Ind	Miscellaneous	NC, Reno, Repl	Water & sewer process	Municipal water and wastewater treatment system optimization, including replacing coarse-bubble aeration with fine-pore aeration, right-sizing pump, impeller trimming, addition of pony pump for smaller loads or VFD, leak reduction, better O&M practices.	Existing practices including coarse-bubble aeration, oversized pumps with no VFD.	10.0	15%	$0.49	0	39	39

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Ind	Miscellaneous	Ret	Water & sewer process	Municipal water and wastewater treatment system optimization, including replacing coarse-bubble aeration with fine-pore aeration, right-sizing pump, impeller trimming, addition of pony pump for smaller loads or VFD, leak reduction, better O&M practices.	Existing practices including coarse-bubble aeration, oversized pumps with no VFD.	10.0	10%	$0.14	0	39	39
Res	Cooling	NC, Reno, Repl	Efficient Window AC ESTAR	Replace room AC with energy star labeled unit; 8-13kbtu, >10.8 EER	Federal standard efficiency window air conditioner, EER 9.8	12.0	9%	$1.53	168	168	168
Res	Cooling	NC, Reno, Repl	Efficient Window AC Tier I	Replace room AC with CEE tier 1 unit; 8-13kbtu, >11.3 EER	Federal standard efficiency window air conditioner, EER 9.8	12.0	13%	$2.14	168	168	168
Res	Cooling	NC, Reno, Repl	Efficient Central AC Tier II	Replace or upgrade standard efficiency central AC with CEE Tier 2 model (SEER 15, EER 12.5)	Federal standard efficiency central air conditioning system, SEER 13, EER 11	18.0	13%	$3.82	168	168	168
Res	Cooling	NC, Reno, Repl	Air Source Heat Pump Tier 2 - Cool	Replace existing electric ASHP cooling system with CEE Tier 2 unit 15SEER, 12.5EER	Standard efficiency, ducted, ASHP, 13 SEER, 11 EER	18.0	13%	$4.40	176	176	176
Res	Cooling	NC, Reno, Repl	Efficient fan motor -Cool	Efficient furnace fan motor (ECM or BPM) to replace standard efficiency (PSC) motors	standard efficiency permanent split capacitor (PSC) motor for central AC	18.0	50%	$1.12	176	168	176
Res	Cooling	Ret	Duct Sealing - Cool	Air-seal duct work to reduce loss of conditioned air into unconditioned space, cooling only	Leaky ductwork within unconditioned space	20.0	33%	$1.83	176	176	127
Res	Cooling	Ret	Air Sealing - Cool	Reduce air leakage in building shell using blower door guidance and durable materials	The building's air leakage before reduction	15.0	5%	$8.29	176	176	1005
Res	Cooling	Ret	Insulation -Cool	Add R-19 insulation to attic	modestly insulated attic (R-25)	25.0	43%	$254.93	176	176	1005
Res	Cooling	NC, Reno, Repl	Efficient Central AC ESTAR	Replace standard efficiency central AC with Energy Star qualified model (SEER 14.5, EER 12)	Federal standard efficiency central air conditioning system, SEER 13, EER 11	18.0	10%	$2.46	176	176	176

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Res	Cooling	NC, Reno, Repl	Air Source Heat Pump ESTAR - Cool	Replace existing electric ASHP cooling system with Energy Star qualified model (SEER 14.5, EER 12)	Standard efficiency, ducted, ASHP, 13 SEER, 11 EER	18.0	10%	$2.84	176	176	176
Res	Whole Building	Ret	Enhanced Behavior based Efficiency initiative	Customer is provided with feedback and guidance to save energy at home.	No Initiative	1.0	2%	$0.03	175	175	175
Res	Indoor Lighting	NC, Reno, Repl	CFL - spiral retail	A CFL replaces an incandescent or halogen general service lamp	A blended average of incandescent and halogen general service lamp	5.5	64%	$0.03	176	176	176
Res	Indoor Lighting	NC, Reno, Repl	CFL - specialty retail	A specialty CFL replaces a specialty incandescent or halogen general service lamp	A blended average of incandescent and halogen specialty lamp	6.8	75%	$0.10	176	176	176
Res	Indoor Lighting	NC, Reno, Repl	CFL fixture, hardwired, interior retail	A CFL fixture replaces an incandescent or halogen general service fixture	A blended average of incandescent and halogen general service lamp	2.8	64%	$0.82	176	176	176
Res	Indoor Lighting	NC, Reno, Repl	LED Recessed Downlight retail	A recessed SSL downlight replaces an incandescent or halogen general service lamp	A blended average of incandescent and halogen general service lamp	20.0	82%	$0.51	176	176	176
Res	Indoor Lighting	NC, Reno, Repl	CFL fixture, hardwired, exterior	A CFL fixture replaces an incandescent or halogen general service fixture	A blended average of incandescent and halogen general service lamp	7.0	64%	$0.30	176	176	176
Res	Indoor Lighting	NC, Reno, Repl	Exterior Motion Sensor	A motion sensor controlled exterior fixture replaces and uncontrolled fixture	an exterior fixture without motion sensor or any other controls	15.0	60%	$0.18	127	127	127
Res	Indoor Lighting	NC, Reno, Repl	LED Screw Based Lamp retail <450 Lumens	A SSL replaces an incandescent or halogen general service lamp	A blended average of incandescent and halogen general service lamp	20.0	79%	$0.24	176	176	176
Res	Indoor Lighting	NC, Reno, Repl	LED Screw Based Lamp retail 450 to 1600 Lumens	A SSL replaces an incandescent or halogen general service lamp	A blended average of incandescent and halogen general service lamp	20.0	32%	$0.24	176	176	176

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Res	Indoor Lighting	NC, Reno, Repl	LED Screw Based Lamp retail >1600 Lumens	A SSL replaces an incandescent or halogen general service lamp	A blended average of incandescent and halogen general service lamp	20.0	56%	$0.29	176	176	176
Res	Miscellaneous	NC, Reno, Repl	Pool Pump	the purchase of a multi speed swimming pool pump capable of running at 50% speed and being run twice as many hours to move the same amount of water through the filter.	Single speed pool pump	10.0	87%	$0.28	176	176	176
Res	Plug Loads	NC, Reno, Repl	Controlled Power Strip	Controlled power strips eliminate standby loads by turning off devices connected to the same power strip as the controlling appliance	Power strip with no control	4.0	82%	$0.28	176	176	176
Res	Plug Loads	NC, Reno, Repl	Desktop Computer, Energy Star labeled	Advanced new power supply designs offer more than 80% efficiency across a wide range of load conditions and often need no cooling fan.	Standard efficiency power supply	4.0	50%	$0.06	127	127	127
Res	Refrigeration	NC, Reno, Repl	Efficient Refrigerator, ESTAR	An Energy Star labeled refrigerator replaces a minimum federal standard efficiency unit	Federal standard efficiency refrigerator	17.0	20%	$0.81	168	168	168
Res	Refrigeration	NC, Reno, Repl	Efficient Refrigerator Tier II	A high efficiency refrigerator replaces a minimum federal standard efficiency unit	Federal standard efficiency refrigerator	17.0	25%	$0.65	168	168	168
Res	Refrigeration	Ret	Refrigerator Retirement	An extra refrigerator is taken out of service	A homeowner has an extra refrigerator running (often in basement, garage or porch)	8.0	100%	$0.33	176	176	176
Res	Refrigeration	Ret	Refrigerator Early Replacement	An aging refrigerator is replaced with a new, energy star model.	An older, inefficient refrigerator remains in use until it dies.	12.0	17%	$1.58	176	176	176
Res	Refrigeration	NC, Reno, Repl	Energy Star Freezer	Customer purchases an Energy Star Freezer instead of baseline	Customer purchases a baseline freezer	12.0	12%	$0.59	176	176	176

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Res	Refrigeration	Ret	Freezer early retirement	An extra freezer is taken out of service	A homeowner has an extra freezer running (often in basement, garage or porch)	8.0	100%	$0.13	127	127	127
Res	Refrigeration	NC, Reno, Repl	Multi Family refrigerator	An CEE tier 2 listed refrigerator is purchased in place of a minimum federal standard efficiency unit	Federal standard efficiency refrigerator	17.0	25%	$0.72	127	127	127
Res	Refrigeration	Ret	Multi Family refrigerator, early replace	A CEE tier 2 listed refrigerator replaces an existing, inefficient refrigerator	An inefficient refrigerator remains in use	17.0	35%	$2.00	127	127	127
Res	Space Heating	NC, Reno, Repl	Air Source Heat Pump Tier 2 - Heat	Replace a standard efficiency electric ASHP with a CEE Tier 2 qualified unit	Standard efficiency, ducted, ASHP, 7.7 HSPF	18.0	9%	$1.71	176	176	176
Res	Space Heating	NC, Reno, Repl	Efficient fan motor -Heat	Efficient furnace fan motor (ECM or BPM) to replace standard efficiency (PSC) motors	standard efficiency permanent split capacitor (PSC) motor for heating system	18.0	50%	$0.83	176	168	176
Res	Space Heating	Ret	Duct Sealing, Heat Pump - Heat	Air-seal duct work to reduce loss of conditioned air into unconditioned space, heat pump	Leaky ductwork within unconditioned space	20.0	33%	$0.50	168	168	127
Res	Space Heating	Ret	Air Sealing, Heat Pump - Heat	Reduce air leakage in building shell using blower door guidance and durable materials	The building's air leakage before reduction	15.0	5%	$1.91	176	176	1005
Res	Space Heating	Ret	Insulation, Heat Pump -Heat	Add R-19 insulation to attic	modestly insulated attic (R-25)	25.0	43%	$8.54	176	176	1005
Res	Space Heating	NC, Reno, Repl	Air Source Heat Pump ESTAR - Heat	Replace a standard efficiency electric ASHP with Energy Star qualified unit, min 8.2 HSPF	Standard efficiency, ducted, ASHP, 7.7 HSPF	18.0	6%	$1.32	176	176	176
Res	Water Heating	NC, Reno, Repl	Clothes Washer - Retail	An efficient clothes washer is purchased in place of a conventional clothes washer. Includes dryer savings for average dryer energy mix	a new conventional clothes washer	14.0	27%	$1.16	176	176	176

Sector	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Res	Water Heating	Ret	Clothes Washer - Early Replacement	Removal of an existing inefficient clothes washer prior to its natural end of life and replacement with a new unit exceeding ENERGY STAR standards. Includes dryer savings for average dryer energy mix	an existing conventional clothes washer	14.0	45%	$2.51	176	176	176
Res	Water Heating	NC, Reno, Repl	Electric Heat Pump Water Heater >55gal	High efficiency heat pump water heater replaces electric resistance water heater, COP>2.0 Measure null; April 2015	Standard efficiency electric resistance water heater, >55 gallons, .90 EF	10.0	48%	$0.53	168	168	168
Res	Water Heating	NC, Reno, Repl	Electric Heat Pump Water Heater <55gal	High efficiency heat pump water heater replaces electric resistance water heater, COP>2.0	Standard efficiency electric resistance water heater, <55 gallons, .90 EF	10.0	48%	$0.53	168	168	168
Res	Water Heating	NC, Reno, Repl	Tank wrap, electric water heater	Additional R-20 insulation blanket, 50 gal water heater	Uninsulated, 50 gal storage water heater	5.0	5%	$0.22	176	176	176
Res	Water Heating	NC, Reno, Repl	Pipe insulation, electric water heater	Add R-3.5 insulation to uninsulated hot water pipes	Uninsulated hot water pipes	15.0	1%	$0.12	176	176	176
Res	Water Heating	NC, Reno, Repl	Multi Family in-unit clothes washer	An CEE tier 2 listed clothes washer is purchased in place of a minimum federal standard efficiency clothes washer	A baseline clothes washer	14.0	43%	$1.23	127	127	127
Res	Water Heating	Ret	Multi Family clothes washer early replace	A CEE tier 2 listed clothes washer replaces an existing, inefficient clothes washer	An inefficient clothes washer remains in use	14.0	54%	$2.53	127	127	127

Gas and Petroleum Measures

Sector	Fuel Type	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Gas	Food Preparation	Ret	Gas kitchen equipment, 2 meal	High-efficiency commercial gas kitchen cooking/warming equipment (holding cabinet, steamer, combination oven, deep fryer, griddle, grill) - 2 meals per day	Non-Energy Star gas-fired commercial kitchen equipment, prototype setup	11.8	33%	$138.7	91, 97	97	97
Com	Gas	Food Preparation	NC, Reno, Repl	Gas kitchen equipment, 3 meal	High-efficiency commercial gas kitchen cooking/warming equipment (holding cabinet, steamer, combination oven, deep fryer, griddle) for a restaurant that serves 3 meals per day	Standard Food Preparation Equipment	11.9	29%	$15.8	91, 97	97	97
Com	Gas	Whole Building	NC, Reno	Commissioning - Fossil Fuel	Whole building commissioning of new buildings to ensure optimized design, installation and operation of systems.	New Construction building with no commissioning performed	7.0	13%	$161.6	25, 54, 55, 56	115	115

Sector	Fuel Type	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Gas/ Petro	Space Heating	NC	Integrated bldg design Tier I - Fossil Fuel	Reflects comprehensive, optimized design of new buildings addressing all end-uses and interactions between them on a systems basis. Measures include, but are not limited to, improved air barrier performance, minimum IAQ performance, lighting controls, improved lighting power density, improved mechanical equipment efficiency, and demand controlled ventilation.	New building conforming to ASHARE 90.1-2007	15.3	36%	$179.6	58	148	184
Com	Gas/ Petro	Space Heating	Ret	Programmable thermostat, fossil fuel heat	Programmable thermostat allows user to automatically cycle space heating equipment on and off to desired set point throughout the day using pre-programmed timers, for gas heat	Assume space heating equipment size of 1,000 Mbtu/h at 75% AFUE	12.0	5%	$11.6	93	116	91
Com	Gas/ Petro	Space Heating	MD	Duct insulation and sealing, FF heat	Seal HVAC ductwork with aerosol-based sealant to reduce air leakage outside the conditioned space and the consequent energy loss.	Leaky and unsealed ducts	25.0	12%	$46.5	119	93	0

Sector	Fuel Type	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Gas/ Petro	Space Heating	Ret	Duct insulation and sealing, FF heat	Seal HVAC ductwork with aerosol-based sealant to reduce air leakage outside the conditioned space and the consequent energy loss.	Leaky and unsealed ducts	25.0	12%	$46.5	119	93	0
Com	Gas/ Petro	Space Heating	Ret	Behavioral Measures -Fossil Fuel Heat, DHW	Includes occupant training, interactive meters w/ real-time pricing capability.	No Behavioral Modification Program	1.0	5%	$12.0	185	0	0
Com	Gas	Water Heating	Ret	Gas boost H2O heater on HE dishwasher	Gas fired boost heater for intake hot water pipe on HE commercial dishwasher	Commercial Dishwasher with a tank temp set to deliver sanitizing water (180° F) without a boost heater	20.0	38%	$3.5	117	97	97
Com	Gas	Water Heating	NC, Reno, Repl	Gas HE tank-type water heater	Gas fired high efficiency stand-alone tank-type water heater	Stand-alone gas-fired tank type water heater with a thermal efficiency of .8	13.0	12%	$15.0	93	116	91
Com	Gas	Water Heating	Ret	Gas HE tank-type water heater	Gas fired high efficiency stand-alone tank-type water heater	Stand-alone gas-fired tank type water heater with a thermal efficiency of .8	13.0	21%	$27.3	93	116	91
Com	Gas/ Petro	Water Heating	Ret	Low-flow showerhead, FF DHW	reduces flow rate on showers	Standard shower head (average rated at 3.25 GPM)	5.0	62%	$2.9	116	91, 1, 116	116
Com	Gas/ Petro	Water Heating	Ret	Faucet aerator, FF DHW	reduces flow rate on sinks	Standard faucet (average rated at 2.2 GPM)	5.0	32%	$22.4	93	91, 1, 116	116
Com	Gas/ Petro	Water Heating	Ret	Pre-rinse spray valves, FF DHW	Reduces flow rate for commercial food service dish pre-rinse sprayers	Pre-rinse spray valve at 3.2 gpm (1.5 hours/per day; 360 day/year. Water temperature rise 70F; gas heater thermal efficiency 0.8)	5.0	4%	$2.3	91	91	91, 177

Sector	Fuel Type	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com	Gas	Water Heating	Ret	Water heater tank insulation, FF DHW	Wrapping a stand-alone water heater in insulating blanket	Stand-alone gas-fired water heater (thermal efficiency .8) without tank insulation	10.0	1%	$21.0	116	91, 1, 116	116
Com	Gas	Water Heating	NC, Reno	Hot water pipe insulation, FF DHW	Wrapping hot water send and return pipes in Insulation	Stand-alone gas-fired water heater (thermal efficiency .8) without outlet pipe insulation	10.0	0%	$3.4	116	91, 1, 116	116
Com/ Ind	Gas/ Petro	Whole Building	Ret	Retrocommissioning -Fossil Fuel	Optimizing energy usage of existing buildings and systems using O&M, control calibration, etc.	A typical existing building that hasn't been commissioned	7.0	16%	$25.9	25, 54, 55, 56	115	115
Com/ Ind	Gas/ Petro	Space Heating	Reno	Deep Energy Retrofit - Fossil Fuel	Deep energy retrofit going after deep savings in every building systems, mostly for the renovation market	Energy use of the existing building, before the deep energy retrofit occurs. Assumes energy use of typical existing building.	20.0	43%	$108.0	143	137	137
Com/ Ind	Gas/ Petro	Space Heating	Ret	Envelope Upgrade	Add attic insulation, wall insulation, and air sealing to small commercial building envelopes	Typical envelope insulation levels and tightness for existing northeastern small commercial buildings	15.0	15%	$86.0	144	149, 152	149
Com/ Ind	Gas/ Petro	Space Heating	NC, Reno, Repl	High-efficiency fossil fuel furnace	Higher Efficiency (typically condensing) gas fired Furnace	Standard efficiency furnace (non-condensing for gas)	15.0	15%	$101.1	93	0	0
Com/ Ind	Gas/ Petro	Space Heating	NC, Reno, Repl	High-efficiency boiler	Higher Efficiency gas or oil fired boiler, AFUE 85% or greater	Standard efficiency gas fired boiler, AFUE 80%	25.0	11%	$236.4	0	116	91
Com/ Ind	Gas/ Petro	Space Heating	NC, Reno, Repl	High-efficiency boiler	Higher Efficiency gas or oil fired boiler, AFUE 85% or greater	Standard efficiency gas fired boiler, AFUE 75%	25.0	17%	$253.3	0	91, 116	91

Sector	Fuel Type	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Com/ Ind	Gas/ Petro	Space Heating	NC, Reno, Repl	High-efficiency gas infrared heater	High efficiency gas-fired infrared heating unit	Standard efficiency gas unit heater	17.0	17%	$15.2	91	91, 116	91
Ind	Gas	Industrial Process	NC, Reno, Repl	Industrial Process - NG	Represents a comprehensive suite of industrial energy efficiency measures addressing Natural gas process energy.	Standard efficiency for aggregated measures	15.0	15%	$45.0	181, 182	181, 182	181, 182
Ind	Gas	Industrial Process	Ret	Industrial Process - NG	Represents a comprehensive suite of industrial energy efficiency measures addressing Natural gas process energy.	Standard efficiency for aggregated measures	15.0	15%	$45.0	181, 182	181, 182	181, 182
Ind	Petro	Industrial Process	NC, Reno, Repl	Industrial Process - Oil	Represents a comprehensive suite of industrial energy efficiency measures addressing Petroleum Fuels process energy.	Standard efficiency for aggregated measures	15.0	15%	$90.0	181, 182	181, 182	181, 182
Ind	Petro	Industrial Process	Ret	Industrial Process - Oil	Represents a comprehensive suite of industrial energy efficiency measures addressing Petroleum Fuels process energy.	Standard efficiency for aggregated measures	15.0	15%	$90.0	181, 182	181, 182	181, 182
Res	Gas/ Petro	Space Heating	Ret	Duct Sealing, Fossil Fuel -Heat	Air-seal duct work to reduce loss of conditioned air into unconditioned space	Leaky ductwork within unconditioned space	20.0	33%	$19.7	168	168	127
Res	Gas	Space Heating	NC, Reno, Repl	Gas Boiler ESTAR	High efficiency gas boiler meeting Energy Star criteria (>85 AFUE)	Gas boiler meeting minimum federal standards (82 AFUE)	18.0	9%	$78.9	176	168	176

Sector	Fuel Type	Primary Fuel End Use	Applicable Markets	Measure Name	Measure Description	Baseline Description	Life (yr)	% Savings	Incre-mental Cost/kWh Saved	Meas-ure Life Source	Savings Data Sources	Costs Data Sources
Res	Gas	Space Heating	NC, Reno, Repl	Gas Furnace ESTAR	High efficiency gas furnace meeting Energy Star criteria (>90 AFUE)	Gas furnace meeting minimum federal standards (80 AFUE)	18.0	11%	$52.9	168	168	168
Res	Petro	Space Heating	NC, Reno, Repl	Oil Furnace ESTAR	High efficiency oil furnace meeting Energy Star criteria (>85 AFUE)	oil furnace meeting minimum federal standards (83 AFUE)	18.0	2%	$258.7	168	168	168
Res	Gas/ Petro	Space Heating	NC, Reno, Repl	Air Sealing, Fossil Fuel -Heat	Reduce air leakage in building shell using blower door guidance and durable materials	The building's air leakage before reduction	15.0	5%	$147.6	176	176	1005
Res	Gas/ Petro	Space Heating	NC, Reno, Repl	Insulation, Fossil Fuel -Heat	Add R-19 insulation to attic	modestly insulated attic (R-25)	25.0	43%	$655.1	176	176	1005
Res	Gas	Water Heating	Ret	Condensing Gas Water Heater >55gal	High efficiency gas condensing storage or on demand water heater	Standard efficiency gas water heater, >55 gallons, .58 EF	13.0	30%	$182.4	176	176	176
Res	Gas	Water Heating	Ret	Condensing Gas Water Heater <55gal	High efficiency gas condensing storage or on demand water heater	Standard efficiency gas water heater, <55 gallons, .58 EF	13.0	30%	$182.4	176	176	176
Res	Petro	Water Heating	NC, Reno, Repl	Water Heating, petroleum fuels	High-efficiency water heating by petroleum fuels	Standard efficiency petroleum-fueled water heating	18.0	10%	$182.4	176	176	176

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APPENDIX F: OTHER ANALYSIS INPUTS AND ASSUMPTIONS

The table below provides a summary of analysis inputs and assumptions, most of which are not specifically described in the report.

Screening Input	Value	Notes
Years of analysis	2014-2025	
Real Discount Rate (RDR)	3%	The U.S. Department of Energy recommendation for projects related to energy conservation, renewable energy, and water conservation is a real discount rate of 3%, as of 2010, consistent with the Federal Energy Management Program (FEMP) (see page 1 in http://www1.eere.energy.gov/femp/pdfs/ashb10.pdf).
Accounting of Costs & Benefits		The items below can be accounted for as costs or benefits. The choice does not affect net benefits, but does affect the benefit-cost ratios (BCRs).
Fossil Fuel Impacts	Costs & Benefits	Savings are benefits, increased usage (e.g., the "heating penalty" for lighting measures) is a cost.
O&M Savings	Benefit	Usually accounted for as a benefit.
Deferred Replacement Credit for Early-retirement Retrofit Measures	Benefit	Usually accounted for as a benefit. When working equipment is retired early for the energy savings of new equipment, the equipment replacement cycle is deferred. The benefit is a portion of the cost that would have been incurred at the end-of-life of the existing equipment (levelized over the remaining life of the efficiency equipment).
Electric Line Loss Factors – Energy	15.7% of meter	EIA data: Average statewide line loss factors over the period 2001-2010 (see http://www.eia.gov/tools/faqs/faq.cfm?id=105&t=3)
Electric Line Loss Factors – Capacity		Not applicable to Phase I
Emission Impact Factors (e.g., SOx and NOx)		Not applicable to Phase I